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PRIMITIVE HUTS AT OSTIA.

OSTIA, about 23 miles from Rome at the mouth of the Tiber, is at present a poor village with scarcely a hundred inhabitants, but in antiquity it was of great importance, being a commercial city of the first rank, a large part of the supplies of Rome being landed there. In the SCIENTIFIC AMERICAN for June 30, 1900, there is an illustrated article on the ruins of ancient Ostia. We now present a hut of the "Contadini" or peasants at Ostia, a number of these strange habitations being found in the vicinity.

During the fever season, which begins early and ends late, the inhabitants dwindle to a dozen in number. In the month of November, some hundreds of peasants arrive from the surrounding country, crowd into huts and cultivate the fertile fields. As soon as the heated term arrives, they hasten away. The lower parts of the huts are usually built of stone, but the upper part is all of thatch covering a framework of small tree trunks. A hole at one end allows the smoke to escape. Of course, the climate being mild there is little or no attempt to maintain a fire for heating purposes. The huts are chiefly interesting from the fact that archæologists are of opinion that these huts are the survival of the primitive huts first erected in Southern Europe. Prof. Lanciani, of the University of Rome, never fails to take his students to a remarkable village which is constructed each autumn on the borders of the (now drained) Lake of Gabii at the twelfth milestone on the Via Prænestina and inhabited by a half-savage tribe of two hundred mountaineers. It is thought the earliest Rome and its contemporary cities must have resembled this temporary village.

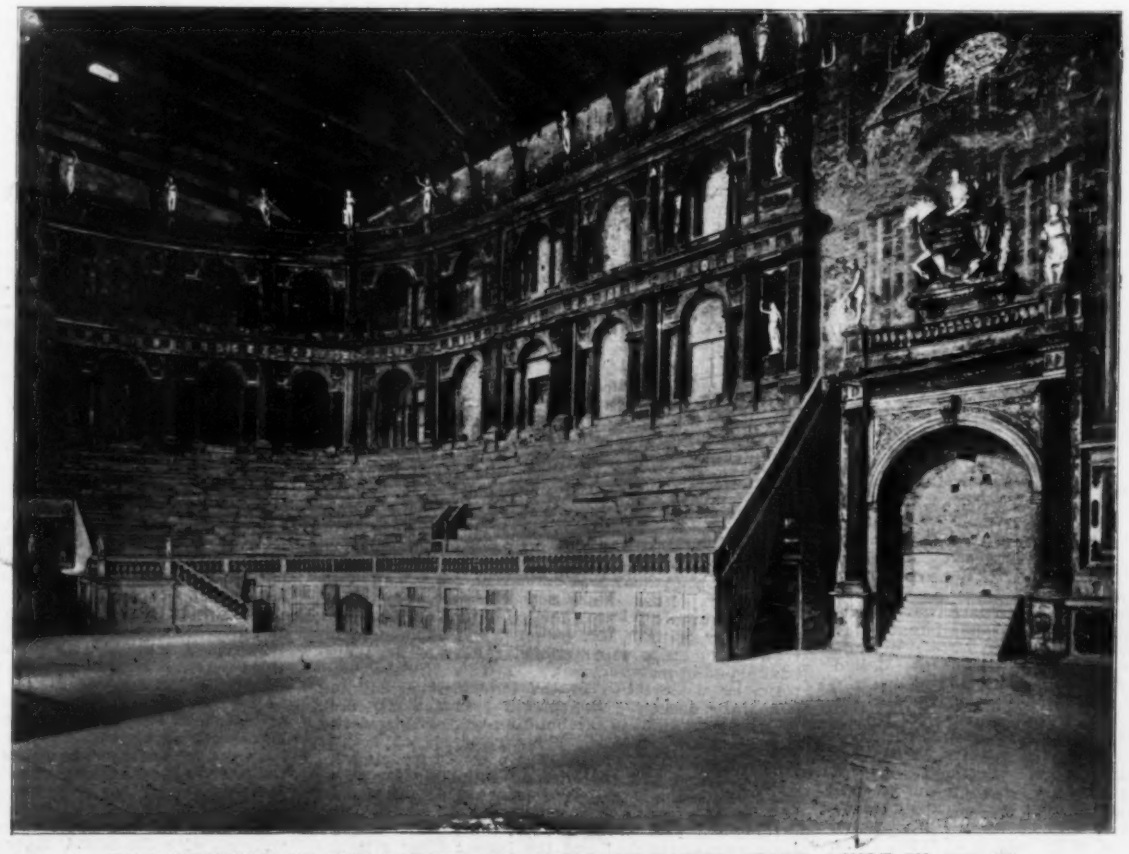
PRIMITIVE THATCHED HUT AT OSTIA.

STEAMSHIP LINES AT PANAMA.—Under date of January 7, 1901, Consul-General Gudger reports from Panama: The contract between the Panama Railroad Company and the Pacific Mail Steamship Company, which has been in existence for the past five years, expired on the 16th day of December, 1900. In consequence of the failure to renew this agreement, the Panama Railroad Company has placed three steamers on the Pacific coast, to ply between San Francisco and Panama. The first vessel to leave this port will be the St. Paul, which sails the 8th instant. The Pacific Steam Navigation Company and the South American Company of Steamships have extended their lines to San Francisco, and the first steamer will leave Panama for that port on the 13th instant. The Pacific Mail Steamship Company has its terminus here at present, but it is thought that this arrangement will not be continued long; except as regards freight to be carried in American bottoms, the Panama Railroad Company and the two southern companies act in harmony.

THE workshops in connection with the Egyptian State Railways were recently opened by the Khedive, and they will soon be in active operation. They cover an immense area, and will afford employment to several hundred Egyptians. British engineers are to superintend the various departments. By the establishment of these shops Egypt is to produce its own rolling stock, locomotives, and other railroad appurtenances, which heretofore have been supplied by foreign manufacturers.

THE FARNESE THEATER AT PARMA.

THE oldest permanent theater in Europe, at least since the time of the Romans, is the Olympian theater of Palladio at Vicenza. We illustrated this curious structure in the SCIENTIFIC AMERICAN for July 16, 1898, and we now show a little later but almost as interesting play-house in Parma. It was built in 1618 by Giambattista Aleotti and shows how the architecture of Palladio dominated everything in the Peninsula, even after the death of the great Vicentine. The theater in the palace at Parma cannot be much later than that at Vicenza. Palladio died in 1580, and the Olympian Theater was not completed by Scamozzi until after his death. Both theaters attempt to reproduce those of classic times. At Parma a semi-circular auditorium with seats on the Roman plan is terminated by a series of boxes admirably fitting into the somewhat heavy architectural background. The effect is considered far more impressive than that produced at Vicenza. No performances have been given in the building for nearly one hundred and fifty years. It is in very bad condition; the seats are rotted to punk and the sky shines in through gashes in the roof, the boxes are dropping down, wasting away and only tenanted by rats. Damp and mildew smear the faded colors, the gay festoons on the proscenium are rags. Charles Dickens has written of it beautifully. He says: "The stage has rotted so that a narrow wooden gallery is thrown across it, or it would sink beneath the tread and bury the vistors in the gloomy depths beneath. The desolation and decay impress themselves on all the senses. The air has a moldering smell and an earthy taste; any stray outer sounds that straggle in with some lost sunbeams are muffled and heavy; and the worm, the maggot, and the rot have changed the surface of the wood beneath the touch, as time will seam and roughen a smooth hand. If ghosts ever act plays, they act them on this ghostly stage."



THE INTERIOR OF THE FARNESE THEATER AT PARMA, ITALY—BUILT IN 1518 BY GIAMBATTISTA ALEOTTI.

CONSUL HUGHES of Coburg, under date of December 12, 1900, writes as follows: The consequences of the disturbances in China are being seriously felt in the silk and tea trade. The Chinese production of silk in 1900 is estimated at 4,500,000 kilograms (9,920,700 lb.). While this is by no means a bad result in itself, yet the uncertain conditions of business make it appear rather risky to import Chinese goods. This accounts for the great demand at Lyons this year for Syrian silk goods. Unfortunately, the present silk crop in Turkey is not very good, so that a rise of prices is probable. The tea trade is in a similar position. The large houses that import are well provided, but there is a scarcity of freight steamers to load the

cargoes. Insurance companies do not like to run risks and refuse to insure Chinese goods, while banks have ceased to advance money on this kind of merchandise. The Ceylon tea plantations will benefit by these conditions.

THE AMERICAN PATENT SYSTEM.*

THE century just closed stands out pre-eminently as the century of invention. It is, therefore, a fitting time briefly to refer to the origin, establishment, and development of our patent system, to call to mind the debt the United States owes to inventors, and at the same time to point out the advantages that have followed the far-seeing wisdom of the framers of the Federal Constitution in incorporating in that instrument Paragraph 8 of Section 8 of Article 1 of the Constitution, which gave to Congress the power "To promote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries."

One hundred years ago the population of the United States was less than six millions, and there was not a single city within our borders having a population of seventy-five thousand. The population of New York, Philadelphia, Baltimore, and Boston was less than the present population of Minneapolis. The latter city and its sister city of St. Paul, Chicago, Omaha, and Kansas City were unknown. Not a steam-propelled vessel was in use, nor was there a mile of railroad in the United States. The electric telegraph and telephone were unknown. Our exports consisted of agricultural products. There was scarcely any well-developed line of manufacture, and our wants in that line were supplied by imports. It had been the policy of England to suppress manufacturing in its colonies. In 1634 a law was passed in Virginia for the encouragement of textile manufactures, but it was promptly annuled by England. In 1731 she enacted a law prohibiting the carriage of woolen goods and hats from one colony to another. In 1750 a woolen hat factory in Massachusetts was declared to be a nuisance and suppressed. No carpets were made in the colonies until after 1776, except rag carpets. In 1800 carpets were in this country a luxury. Even up to 1850 there was not a power loom for carpet making in the United States.

What is true in the textile art is equally true of most of the other arts.

Though the country was an agricultural one, little progress had been made in the manufacture of agricultural implements. It was not until 1819 that a plow was produced in this country. The reaper appeared in 1833, and a successful thrasher not until 1850. Up to the time of the civil war there is no question but that the country continued to be an agricultural one. It is true that during the first sixty years of the last century our manufactures steadily and rapidly increased in kind and in extent, but our population increased even more rapidly, so that we consumed what we manufactured and were still largely dependent upon the import of manufactured articles. But in the last few years a great reversal, not only in sentiment, but in conditions, has occurred; the commercial relations of the United States with the great trading nations of the world have rapidly changed, so that the excess of imports of manufactured articles has turned into an excess of exports of such articles.

One need not look far for the cause of this. It lies in the economy of manufacture arising from the use of labor-saving devices, mainly the invention of our own people, which has enabled us to compete in many lines of manufacture, notwithstanding the higher scale of wages paid in this country, with similar articles manufactured by any or all nations. To employ these devices to the best advantage requires the intelligence of the American workmen, and the result is due to the combination of witty inventions and thinking men. Witless men behind witty machines would be of no use. To the patent system more than to any other cause are we indebted for the industrial revolution of the century.

President Washington realized the importance of formulating a law to stimulate inventions, and in his first annual message to Congress, in 1790, said:

"I cannot forbear intimating to you the expediency of giving effectual encouragement as well to the introduction of new and useful inventions from abroad as to the exertion of skill and genius in producing them at home."

Congress was quick to act, and on April 10, 1790, the first law upon the subject was enacted. It constituted the Secretary of State, the Secretary of War, and the Attorney-General a board to consider all applications for patents. Owing to the fires that have destroyed the early records of the Patent Office some question has arisen as to the number of patents issued under this act, but from the best information obtainable I place the number at fifty-seven. The first patent issued was to Samuel Hopkins, July 31, 1790, for making pot and pearl ashes.

The Act of 1793 superseded the Act of 1790 and remained in force as amended from time to time until the Act of 1836 was passed. The Act of 1793 was the only act ever passed in this country which provided for the issuance of letters patent without the requirement of an examination into the novelty and utility of the invention for which the patent was sought.

The Act of 1836, with modifications, remained in force until the revision of the Patent Laws in 1870. This revision was largely a consolidation of the statutes then in force.

Under the revision of the Statutes of the United States in 1874 the Act of 1870 was repealed, but the revision substantially re-enacted the provisions of the Act of 1870.

Under the Acts of 1790 and 1793 letters patent were granted for a term of fourteen years. There was no provision for extension; but while the Act of 1793 was in force Congress extended some thirteen patents.

The Act of 1836 provided that letters patent should be granted for a term of fourteen years, and provision was made for an extension for a term of seven years, upon due application and upon a proper showing. Until 1848 petitions for extensions were passed upon by a board consisting of the Secretary of State, the Commissioner of Patents, and the Solicitor of the Treasury. After that time power was vested solely in the Commissioner of Patents.

The Patent Act of March 2, 1861 (Section 16) provided that all patents thereafter granted should remain in force for a term of seventeen years from the date of issue; and the extension of such patents was prohibited.

The Consolidated Patent Act of 1870, while providing that patents should be granted for a term of seventeen years, also provided that patents granted prior to March 2, 1861, might upon due application and a proper showing be extended by the Commissioner of Patents for a term of seven years from the expiration of the first term.

By the revision of the Patent Laws in 1874 the prohibition against the extension of patents was dropped, and since that time Congress has had the power to extend letters patent. Congress extended five patents granted under the Act of 1836, and in nine instances authorized patentees to apply to the Commissioner of Patents for extension of their patents. So far as I have been able to discover no patent granted for a term of seventeen years has been extended by Congress.

It was not until in 1842 that the statute was passed authorizing the grant of patents for designs. Under that act design patents were granted for seven years; subsequently provisions were made for granting them for terms of three and one-half, seven and fourteen years, at the election of the applicant.

By the Act of March 2, 1861, the Board of Examiners-in-Chief was established. Prior to that time, and during the incumbency of Commissioner Holt, temporary boards of examiners to decide appeals had been appointed by him, and later on he created a permanent board of three examiners who were to decide on appeal rejected cases and submit their decisions to him for approval.

The Act of 1870 made the first provision for an Assistant Commissioner and an Examiner of Interferences. Another provision in that act was the power given the Commissioner, subject to the approval of the Secretary of the Interior, to establish regulations for the conduct of proceedings in the office.

On January 1, 1898, an act passed March 3, 1897, went into force. Some of the provisions of this act were that applications for patents should be completed and prepared for examination within one year after the filing of the application, and that the applicant should prosecute the same within one year after an action thereon or it should be regarded as abandoned (prior to that time two years was the limit); that an inventor should be debarred from receiving a patent if his invention had been first patented by him, or his legal representatives or assigns, in a foreign country, provided the application for the foreign patent had been filed more than seven months prior to the filing of the application in this country; and that if the invention for which a patent was applied for had been patented or described in any printed publication in this or any foreign country for more than two years prior to the application, a patent could not issue.

The growth of the Patent Office has kept pace with the remarkable growth of the United States during the last century. The records of the Treasury Department, Register's Office, contain a report signed by Joseph Nourse, Register, which would indicate that no salaries were paid to employes of the Patent Office until 1803. It is impossible to determine whether they were paid directly by the inventors, by a system of percentage, allowed to retain a certain portion of the patent fees, or whether they were really employed in some other capacity and simply detailed to attend to the work of the Patent Office. In 1816 the personnel of the Patent Office consisted of a superintendent, a clerk, and a messenger, receiving in salaries $1,772. The office force now numbers 679, and the salaries paid during the past year amounted to $761,691.60. While the expenses of the Patent Office have enormously increased, the receipts have more than kept pace with them. The receipts for the past year were upward of $1,350,000, with expenses of about $1,260,000. The receipts from 1836 to the present time have exceeded the disbursements by $5,177,458.55.

The first provision for affording accommodations for the Patent Office was in 1810, when Congress authorized the purchase of a building for the General Post Office and for the office of the Keeper of Patents. The building purchased was known as Blodgett's Hotel, and stood on the site now occupied by the south front of the building until recently occupied by the Post Office Department, and now used by several bureaus of the Interior Department. The east end of this building was used for the records, models, etc., of the Patent Office. This building was destroyed by fire December 13, 1836. On July 4, 1836, an act was passed appropriating $108,000 for the erection of a suitable building for the accommodation of the Patent Office, and within that month the erection of the building was begun. It was the present south front of the Patent Office, excluding the south ends of the east and west wings. The basement (which is now the first or ground floor) was to be used for storage and analogous purposes; the first or portico floor for office rooms, and the second floor was to be one large hall with galleries on either side and to have a vaulted roof. This hall was to be used for exhibition purposes, for the display of models of patented and unpatented inventions, and also as a national gallery of the industrial arts and manufactures.

During the erection of the Patent Office building temporary quarters were provided in the city hall. In the spring of 1840 the building was completed and the office moved into it. The sum of $422,011.65 was expended on this building. The patented models were then classified and exhibited in suitable glass cases, while the national gallery was arranged for the exhibition of models and specimens.

By the Act of March 3, 1849, the Interior Department was established and the Patent Office attached thereto. This same act appropriated $50,000 out of the patent fund to begin the east or Seventh Street wing, which was completed in 1852 at a cost of $600,000, $250,000 of which was taken from the revenue of the Patent Office. In 1852 the plans for the entire building as it now stands were prepared. The west wing was completed in 1856 and cost $750,000. Work on the north of C Street wing was begun the same year. In 1867 this wing was finished at a cost of $575,000. The entire building cost $2,347,011.65. If this building was devoted solely to the use of the Patent Office it would not satisfy its requirements. Substantially all of the models have been crowded out and are now stored in a rented building. A part, at least, if not all, of the surplus of over five millions of dollars paid by the inventors of the country should be used for the erection of a building that would be suitable for the business of the office and which at the same time would be a fitting monument to the genius of American inventors. The propriety and justice of such action has recently been forcibly presented by the senior Senator from Virginia. He said, in part:

"Other nations have surpassed us in literature and the fine arts, but in inventive and useful arts the United States is far transcendent. The Patent Office, established by Thomas Jefferson and protecting for a brief period the only constitutional monopoly, the right to the exclusive enjoyment of one's original ideas, is the crown of American intellectual supremacy over the material world, even as the Constitution of the United States is the crown of political architecture and the Union itself the crowning glory of our people.

"As Francis Bacon says, 'The sciences dwell sociably together,' and we should put on Capitol Hill, facing the Senate Hall, as a companion piece to the exquisite Library building now facing the Hall of Representatives, another building of like architecture. And the Americal capitol of letters should have by its side the American capitol of inventive art, both facing the Capitol of the people; where their sovereignty has its highest exemplification. In that hall should be displayed the evolutions of inventions, with every invention indicated by its model, inclusive of the last improvement. It would be the greatest college of applied science that the world has ever seen; a monument to and a stimulus to invention, and leading by gradations to those truths of science which hover over the threshold of the age, 'waiting to be caught.'"

Since July 28, 1836, 667,173 patents for inventions and since 1842 34,018 patents for designs have been issued by this office. Many of these patents are for minor improvements, but among them may be found a very large number covering the most remarkable and valuable inventions which have added untold sums to the world's wealth, revolutionized the old arts, created new ones, brought old time luxuries within the reach of all, and made life doubly worth living. These contributions have come from men and women, white and colored. To many inventors more than a hundred patents have been issued. The following are some of the inventors who have received more than that number between 1872 and 1900, both years inclusive:

Thomas A. Edison	742
Francis H. Richards	619
Elihu Thomson	444
Charles E. Scribner	374
Luther C. Crowell	293
Edward Weston	280
Rudolph M. Hunter	276
Charles J. VanDepoele (deceased)	245
George Westinghouse	239
John W. Hyatt	209
Freeborn F. Raymond, 2d	182
Sydney H. Short	178
Rudolf Eickemeyer (deceased)	171
Milo G. Kellogg	159
Walter Scott	156
Arthur J. Moxham	150
Cyrus W. Saladee	148
Louis Goddu	146
Hiram S. Maxim	146
George D. Burton	144
Lewis H. Nash	142
Edwin Norton	141
Abbot Augustus Low	137
Philip Diehl	137
James C. Anderson	135
Edward J. Brooks	133
Elmer A. Sperry	132
Peter K. Dederick	128
Hosea W. Libbey	127
James F. McElroy	121
William N. Whiteley	121
Horace Wyman	118
Frank Rhind	117
Louis K. Johnson	114
Warren H. Taylor	112
James M. Dodge	111
George H. Reynolds	110
Talbot C. Dexter	109
James H. Northrop	102

From 1790 to March 1, 1895, some 5,535 patents were granted to women. It is a fair estimate that out of every one thousand patents one is granted to a woman. As a rule women take out but one patent, although there are many exceptions. While the majority of patents granted them are for improvements in wearing apparel and in articles for household use, they have invented and received patents for adding machines, windmills, horseshoes, agricultural implements, and fire escapes.

To some one hundred and sixty-five colored inventors about four hundred patents have been issued; twenty-eight patents have been issued to one, and to another twenty-two. So far as the records show, Henry Blair, of Maryland, was the first colored patentee. In 1834 he received a patent for a corn planter, and in 1836 one for a cotton planter. The character of their inventions follow lines suggested by their employment. Employed in the field and in the house, improvements in agricultural implements and articles of domestic use predominate. The sphere of their inventive effort has widened with the added opportunities afforded them to engage in mechanical avocations. They have made contributions to the electric arts and steam engineer-

* Extract from the Annual Report of the Commissioner of Patents.

ing, and many improvements in railway appliances and paper bag machines. Before the civil war the master of a slave living in Mississippi made application for a patent, but the Attorney-General held in an opinion reported in Vol. 9, Attorney-General's Opinions, page 171, that an invention of a slave, though it be new and useful, could not be patented.

In May, 1802, President Jefferson appointed Dr. William Thornton as a clerk, at $1,400 per year, to have charge of the issuance of patents. He took the title of Superintendent, and continued to act in that capacity until his death, March 28, 1828. He was succeeded by Dr. William P. Jones, who acted until his removal in the early part of President Jackson's administration. John D. Craig followed Dr. Jones, and in 1834 he was succeeded by B. F. Pickett, who served but a brief period. The last Superintendent was Henry L. Ellsworth, who became the first Commissioner under the Act of 1836, and served until 1845. The other Commissioners under that act were:

Edmund Burke	May 4, 1845
Thomas Ewbank	May 9, 1849
Silas H. Hodges	November 8, 1852
Charles Mason	May 16, 1853
Joseph Holt	September 10, 1857
William D. Bishop	May 27, 1859
Philip F. Thomas	February 16, 1860
D. P. Holloway	March 28, 1861
J. C. Theaker	August 17, 1865
Elisha Foote	July 29, 1868
Samuel S. Fisher	April 26, 1869

Commissioner Fisher continued as Commissioner for a short time under the Act of 1870. Other Commissioners under that act have been:

M. D. Leggett	January 16, 1871
John M. Thatcher	November 4, 1874
R. H. Duell	October 1, 1875
Ellis Spear	January 30, 1877
H. E. Paine	November 1, 1878
E. M. Marble	May 7, 1880
Benjamin Butterworth	November 1, 1883
M. V. Montgomery	March 23, 1883
B. J. Hall	April 12, 1887
C. E. Mitchell	April 1, 1889
William E. Simonds	July 1, 1891
John S. Seymour	March 31, 1893
Benjamin Butterworth	April 7, 1897
Charles H. Duell	February 3, 1898

Commissioner Fisher was the first to publish his decisions and to have the copies of the specifications and drawings made by photolithography. He also instituted the practice of requiring competitive examinations for entrance to and promotions in the examining force of the office.

Beginning in 1843, and annually thereafter, the Patent Office reports were published, which until 1853 contained merely an alphabetical index of the names of the inventors, a list of the expired patents, and the claims of the patents granted during the week. In 1853 and afterward small engraved copies of a portion of the drawings were added to the reports to explain the claims.

The Act of 1870 authorized the Commissioner to print copies of the claims of the current issues of patents and of such laws, decisions, and rules as were necessary for the information of the public. In conformity with this provision there was published weekly a list giving the numbers, titles, and claims of the patents issued during the week immediately preceding, together with the names and residences of the patentees. This list was first published under the name of The Official Gazette of the United States Patent Office on January 3, 1872. In July, 1872, portions of the drawings were introduced to illustrate the claims in the patented cases. The Official Gazette has now become one of the most valuable and important of government publications. Each Senator and Representative is authorized to designate eight public libraries to receive this publication free. One copy is also furnished free to each member of Congress. It is also sent all over the world in exchange for similar publications by other governments, and its paid subscription list is constantly increasing.

The American patent system is known and spoken of as the "Examination System" in contradistinction from the English system, which has been mainly followed by other nations. The examination system is the ideal system, provided the examination can be made with sufficient care to minimize the likelihood of the issue of patents for inventions not of a patentable nature. The field of search, however, yearly increases and it becomes more and more difficult, through lack of time, to make a perfect examination. Something more than two million domestic and foreign patents have been issued, while the number of scientific publications has enormously increased. It is only by means of a perfect classification that this great mass of matter can be so divided as to be conveniently accessible for use in the examination of any individual case. Of our patent system it has well been said:

"It is generally recognized by the most profound students of our institutions, both at home and abroad, that no one thing has contributed more to the preeminence of this country in the industrial arts and in manufactures than the encouragement given by our Constitution and laws to inventors and to investors in patent property."

The system is by no means perfect, but it is generally acknowledged that the patent laws of the United States are more liberal than those of any other country, and that the examination, imperfect though at times it be, gives a value to a United States patent not possessed by a patent issued by a country not having an examination system. It is undoubtedly true that the practice before the Patent Office lacks stability and uniformity by reason of the frequent changes of Commissioners, which prevents the establishment of definite policies. The salaries paid to the Commissioner and Assistant Commissioner, to the Examiners-in-Chief, and to the examiners of the various grades are inadequate. It is also true that too many appeals are permitted, and interference proceedings are rendered onerous and complicated by the number of motions and appeals provided by the laws and rules. The most serious defect, however, follows from the power to keep applications in the office for indefinite times through delays in amending the same. The Act of March 3, 1897, was intended to prevent or check this evil, but it has failed of its purpose. At the present time about seventy-five per cent of the patents granted are issued within one year after being filed, and, were it not for the fact that applications are unduly delayed, at least ninety per cent would issue within that time. The rights of the public would be protected, and very seldom would an injustice be done to an inventor, if a provision was incorporated into the present laws providing that unless an application became involved in an interference it should not be permitted to remain in the Patent Office more than three years without abridging its life of seventeen years.

The records of the office show that there are pending 4,829 applications filed prior to January 1, 1898; 3 of these applications were filed in 1880, 1 in 1881, 4 in 1882, 3 in 1884, 3 in 1885, 13 in 1886, 7 in 1887, 13 in 1888, 19 in 1889, 23 in 1890, 45 in 1891, 64 in 1892, 103 in 1893, 154 in 1894, 368 in 1895, 992 in 1896, and 3,011 in 1897.

It will be seen, therefore, that an application may be kept alive indefinitely, if it be desired. While the list above given embraces only such applications as were filed under the law as it existed prior to January 1, 1898, yet ten years from now a similar list will undoubtedly be given, provided the statutes are not amended, for the only difference lies in the fact that amendments now have to be made within a year after the official action, instead of two years under the prior act. A law which permits this should be corrected.

It should continue to be the policy of the government of a nation whose inventors have given to the world the cotton gin and the reaper, the sewing machine and the typewriter, the electric telegraph and telephone, the rotary web perfecting printing press and the linotype, the incandescent lamp and the phonograph, and thousands of other inventions that have revolutionized every industrial art, to encourage invention in every lawful way, and to provide that, so far as may be necessary, the money paid to the government by inventors be used for their benefit. The wisdom of the policy has been demonstrated.

The world owes as much to inventors as to statesmen or warriors. To them the United States is the greatest debtor, so much have they advanced American manufactures. Their labor-saving machinery does work that it would take millions of men using hand implements to perform. In this century the debt will be piled still higher, for inventors never rest.

Respectfully submitted,

C. H. DUELL,
Commissioner of Patents.

THE PREPARED MUSTARDS OF COMMERCE.

THE mustard, i. e. the flour or powdered seed used in preparing the different condiments, is derived from three varieties of Brassica (*Cruciferae*)—*Brassica alba L., Brassica nigra*, and *Brassica juncea*. The first yields the "white" seed of commerce, which produces a mild mustard; the second the "black" seed, yielding the more pungent powder, and the latter a very pungent and oily mustard, much affected by the Russians. The pungency of the condiment is also affected by the method of preparing the paste, heating destroying the sharpness completely, if carried too far. The pungency is further controlled and tempered, in the cold processes, by the addition of wheat or rye flour, which also has the advantage of serving as a binder of the mustard. The mustard flour is prepared by first decorticating the seed, then grinding to a fine powder, the expression of the fixed oil from which completes the process. This oil, unlike the volatile, is of a mild, pleasant taste, and of a greenish color, which, it is said, makes it valuable in the sophistication and imitation of "olive" oils, refined cottonseed or peanut oil being thus converted into *huile vierge de* Lucca, Florence, or some other noted brand of olive oil. It is also extensively used for illuminating purposes, especially in Southern Russia.

The flavors, other than that of the mustard itself, of the various preparations are imparted by the judicious use of spices—cinnamon, nutmeg, cloves, pimento, etc.—aromatic herbs, such as thyme, sage, chervil, parsley, mint, marjoram, tarragon, etc., and finally chives, onions, shallots, leeks, garlic, etc.

In preparing the mustards on a large scale, the mustard flour and the wheat or rye flour are mixed and ground to a smooth paste with vinegar, must (unfermented grape juice), wine, or whatever is used in the preparation, a mill similar to a drug or paint mill being used for the purpose. This dough immediately becomes spongy, and in this condition, technically called "cake," is used as the basis of the various mustards of commerce.

MUSTARD CAKES.

In the mixture, the amount of flour used depends on the pungency of the mustard flour, and the flavor desired to be imparted to the finished product. The cakes are broadly divided into the yellow and the brown. A general formula for the yellow cake is:

	Per Cent.
Yellow mustard	from 20 to 30
Salt	from 1 to 3
Spices	from ¼ to ½ of 1
Wheat flour	from 8 to 12

Vinegar, must, or wine, complete the mixture.

The brown cake is made with black mustard, and contains about the following proportions:

	Per Cent.
Black mustard	from 20 to 30
Salt	from 1 to 3
Spices	from ¼ to ½ of 1
Wheat or rye flour	from 10 to 15

The variations are so wide, however, that it is impossible to give exact proportions. In the manufacture of table mustards, in fact, as in every other kind of manufacture, excellence is attained only by practice and the exercise of sound judgment and taste by the manufacturer. With these facts before you, we present you with the formulæ for some of the best-known brands of imported table mustards:

MOUTARDE DES JESUITTES.

Twelve sardels and 280 capers are crushed into a paste and stirred into 3 pints of boiling wine-vinegar. Add 4 ounces of brown cake and 8 ounces of yellow cake and mix well.

KIRSCHNER WINE MUSTARD.

Reduce 30 quarts of freshly expressed grape juice to half that quantity, by boiling over a moderate fire, in a water bath. Dissolve in the boiling liquid 5 pounds of sugar, and pour the sirup through a colander containing 2 or 3 large horseradishes cut into very thin slices and laid on a coarse towel spread over the bottom and sides of the colander. To the colate add the following, all in a state of fine powder:

Cardamon seeds	2½ drams
Nutmeg	2½ drams
Cloves	4½ drams
Cinnamon	1 ounce
Ginger	1 ounce
Brown mustard cake	6 pounds
Yellow mustard cake	9 pounds

Grind all together to a perfectly smooth paste, and strain several times through muslin.

DUESSELDORFF MUSTARD.

Brown mustard cake	10 ounces
Yellow mustard cake	48 ounces
Boiling water	96 ounces
Wine vinegar	64 ounces
Cinnamon	5 drams
Cloves	15 drams
Sugar	64 ounces
Wine, good white	64 ounces

Mix after the general directions given above.

GERMAN TABLE MUSTARD.

Laurel leaves	8 ounces
Cinnamon	5 drams
Cardamon seed	2 drams
Sugar	64 ounces
Wine vinegar	96 ounces
Brown cake	10 ounces
Yellow cake	48 ounces

Mix after general directions, as given above.

KREMS MUSTARD—SWEET.

Yellow cake	10 pounds
Brown cake	20 pounds
Fresh grape juice	6 pints

Mix and boil down to the proper consistency.

KREMS MUSTARD—SOUR.

Brown mustard flour	30 parts
Yellow mustard flour	10 parts
Grape juice, fresh	8 parts

Mix and boil down to a paste and then stir in 8 parts of wine vinegar.

TARRAGON MUSTARD.

Brown mustard flour	40 parts
Yellow mustard flour	20 parts
Vinegar	6 parts
Tarragon vinegar	6 parts.

Boil the mustard in the vinegar and add the tarragon vinegar.

TARRAGON MUSTARD—SHARP.

This is prepared by adding to every 100 pounds of the above 21 ounces of white pepper, 5 ounces pimento, and 2½ ounces cloves, mixing thoroughly by grinding together in a mill, then put in a warm spot and let stand for 10 days or 2 weeks. Finally strain.

MOUTARDE AUX EPICES.

Mustard flour, yellow	10 pounds
Mustard flour, brown	40 pounds
Tarragon	1 pound
Basil, herb	5 ounces
Laurel leaves	12 drams
White pepper	3 ounces
Cloves	12 drams
Mace	2 drams
Vinegar	1 gallon

Mix the herbs and macerate them in the vinegar to exhaustion, then add to the mustards, and grind together. Set aside for a week or 10 days, then strain through muslin.

Another Form—Also called Moutarde Aromatisée.

Boil together 20 pounds of brown and 40 pounds of yellow mustard flour in 1 gallon of vinegar; then add oil of tarragon, 1 ounce; oil of thyme, 4 drams; oil of mace, 2 drams; oil of cloves, 75 minims, dissolved in 4 ounces alcohol, and a pint of the strongest vinegar.

MOUTARDE HYGIENIQUE.

Yellow mustard flour, 20 ounces; brown mustard flour, 12 ounces; salt, 3 ounces; wine vinegar, 16 ounces. Make a tincture of pimento, 3 drams; cassia-bark, 1 dram; ginger, 1 dram; white pepper, 1 dram; alcohol, 12 drams. Let stand for several days, then add to the mustard, and grind together with 3 ounces of sugar and 8 ounces of water.

NOTA BENE.

In all the foregoing formulæ where the amount of salt is not specified, it is to be added according to the taste or discretion of the manufacturer.

Tarragon vinegar is made by macerating 1 part of tarragon (the herb) in 10 parts of strong white wine vinegar.

Mustard vinegar is prepared as follows:

Celery, chopped fine	32 parts
Tarragon, the fresh herb	6 parts
Cloves, coarsely powdered	6 parts
Onions, chopped fine	6 parts
Lemon peel, fresh, chopped fine	3 parts
White wine vinegar	575 parts
White wine	515 parts
Mustard seed, crushed	100 parts

Mix and macerate together for a week or 10 days in a warm place, then strain off.

The formulæ for Ravigotte and other French mustards have been given so recently that we need not repeat them here.—National Druggist.

THE BUREAU FOR TESTING PAPER AT THE PARIS CHAMBER OF COMMERCE.

THE stages of human civilization have been named, often fancifully, but sometimes with appositeness, according to the instruments employed or the results obtained at the different epochs. Thus, we have the Stone Age and the Iron Age; the Renaissance was called the Age of Art; and the reign of Louis XIV. the Era of Glory. Would it not be just to give a title also to the period that we are passing through? Should we seek one, we should probably find none more apropos than that of the Age of Paper. At present

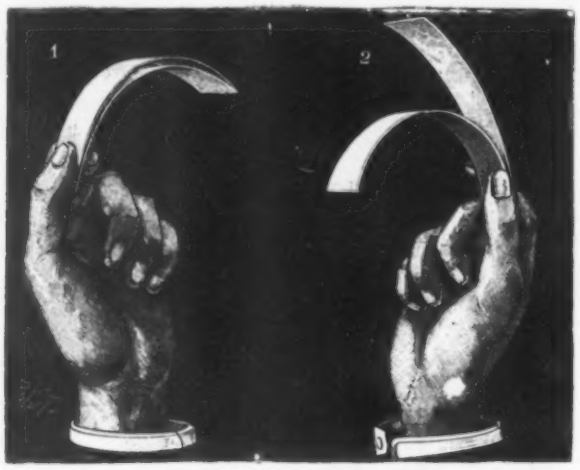


FIG. 1.—METHOD OF ASCERTAINING THE DIRECTION OF THE FIBERS OF PAPER.

everything is made by paper. The public wealth is paper, instruction is disseminated through paper, and the press, the influence of which is so great, exists only through paper. There is no trade or industry in which paper does not always play a predominant rôle.

By itself it is certainly nothing, but by what it represents it is everything. Now, in order to protect the idea of which it is the witness, it is indispensable to occupy ourselves with the material itself. So, the manufacture of paper has in recent years been greatly developed. The mills are giving employment to a larger and larger number of persons, and the machinery used for the manufacture of it is daily becoming more perfect and productive.

It was, therefore, important that the Paris Chamber of Commerce, which always takes the precedence in the defense of collective interests from the viewpoint of transactions, should occupy itself with the question. So, in its service of conditioning silks it has installed a separate bureau for the verification of every quality of paper presented. This office, which is located in the apartments of the Bourse du Commerce, is under the direction of the distinguished chemist, M. Persoz. It furnishes results that offer every guarantee of accuracy, and although its reports have not as yet the value of legal documents, they have at least a consultative value, and may in the majority of cases be referred to with confidence.

We shall now enumerate the different tests to which the specimens of paper presented are submitted. These may be divided into two categories, viz., me-

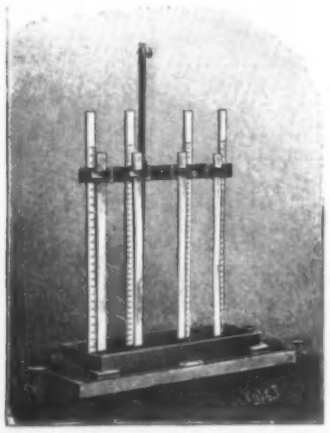


FIG. 2.—APPARATUS FOR GIVING THE DEGREES OF ABSORPTION OF BLOTTING PAPER.

chanical and chemical. The more important is assuredly that which furnishes data as to the resistance of the material. The apparatus used in this case is a dynamometric one that gives both the weight of rupture and the elongation before rupture (Fig. 3). The apparatus consists in principle of two jaws, the regular spacing of which is obtained by means of a winch that actuates a screw, and of a rigid transmission A special gearing causes a large needle to displace itself in front of a divided quadrant in a measure as the jaws separate from each other, and gives at the moment of stoppage an indication which may be plainly read, and which is the weight of breakage sought. It will be understood that if a band of paper be placed between the jaws and the apparatus be maneuvered the needle will begin to oscillate, and, at the moment of rupture, will stop in front of a division that will indicate the force necessary to effect a rupture of the specimen considered. An addition to this ingenious apparatus permits at the same time of reading the elongation of the same specimen from the moment that it was placed between the jaws until it broke.

Let us say, by the way, that these specimens put to the test are bands of paper 0.5 of an inch in width. The tests are twofold and are made upon bands taken in the direction of the fibers of manufacture and in a transverse direction. In fact, the paper offers very different resistances according as the operation is performed in one direction or the other. Thus, such or such a quality of paper submitted to the apparatus may break under a weight of 94 pounds to the square inch taken in the direction of the fibers and under a weight of 47 pounds taken in a transverse direction.

It is sometimes very difficult and even often impossible to recognize the direction of the fibers of manufacture. For doing this the following is an extremely simple process due to M. Nickel. From a sheet of paper, cut out two bands 0.5 of an inch in width, one in a longitudinal and the other in a transverse direction, and hold them together by one of their extremities. If they be allowed to fall over on one side, the two bands will remain united, but if they be made to fall over on the other side one will take on considerable of a curve, while the other will stand nearly erect. It is the latter that will give the specimen taken in the direction of the fibers, while the former will be the one that is taken in a transverse direction. This experiment is as simple as it is ingenious.

Five specimens of the paper taken in each direction are submitted to experiment, and averages are taken for the results giving the weights of rupture as well as for those giving the elongation.

It may be readily understood that the results obtained, although very exact in themselves, since the apparatus has been verified and controlled, do not speak to the mind, since the same quality of paper will give different indications according to the thickness of specimen considered. So it is customary to indicate the result in a figure that represents the length of a band of paper that would be necessary to allow the rupture to take place by its own weight. Thus a specimen that breaks under a weight of 96.5 pounds to the square inch would have to have a length of 17,426 feet in order to break under its own weight, whatever be the thickness of the piece put to the test.

By changing the jaws of the apparatus spoken of above, it is possible, through a special arrangement, to obtain data as to the resistance of the paper to perforation (see cartouche in Fig. 3). To this effect there is employed an iron hoop over which the paper may be stretched like the head of a drum. The second part is a rounded piston which rests upon the taut paper. The results give the weight necessary for the perforation at the exact moment at which the latter takes place. It has been remarked that there is no relation between the resistance of paper to traction and the resistance to perforation.

The mechanical tests of the paper are extended also to its thickness. For this purpose the well-known instrument called the Palmer screw gage is employed. This gives hundredths of a millimeter. Different experiments are made with packages of sheets varying as to number, and an average is taken of the tests expected. The weight of the paper to the square foot is also determined. This experiment is made in order to ascertain how many sheets to 100 pounds will be obtained, or rather to find what weight of paper it will require to cover a definite surface. To make such a test it suffices to measure a sheet of paper accurately and afterward weigh it.

The following experiment to which the paper is submitted serves to determine the resistance to folding, crumpling, and crushing. This is very important, since certain papers, like those used in the manufacture of bank notes, etc., pass through many hands. It is, therefore, necessary, before printing, to be exactly informed as to the resistance that the paper will present to use. Different apparatus have been devised for such a test, but they have not as yet entered into the domain of practice. The most usual method is to operate by hand. The sheet is first folded in one direction, then in a direction at right angles, and then diagonally, and finally in a direction at right angles with the diagonal. The specimen that exhibits an aperture at the first folding is considered very bad and that which resists the four foldings may be very good. In order to prove its real resistance it must be submitted to new tests. The specimen is formed into a ball and is compressed. Then a second and a third ball is made of it. If the paper has resisted this test it is placed between the two hands and submitted to friction. The majority of papers do not resist such tests. It has been found that there exists a very sensible correlation between the resistance of the paper to traction and its resistance to friction.

The other tests that are made have reference to the composition and chemical qualities of the paper. The first thing that the operator does is to examine the nature of the fibers that enter into the composition of the pulp from which the paper was made. This is done by means of a microscope. The paper is first cut into small strips, which are boiled in a one per cent caustic solution that removes the size. The pulp formed is collected upon wire gauze and carefully washed, and then a few particles are removed and submitted to the action of a solution of iodide of potassium. If, when the fibers are examined under the microscope they present a brown color, it indicates cotton, hemp, flax, or ramie, while a yellow color will indicate the existence of jute, and the entire absence of color will indicate alfa, wood pulp, and wood and straw pulp. The form of the fibers likewise gives indications. Thus, straw will furnish oblong cells having a vague resemblance to the soles of shoes and sometimes to saw blades. Alfa reveals itself by very fine fibers, saw teeth, and forms resembling those of the bacilli of cholera. Cotton shows itself under the form of a ribbon with swellings and spirals. Wood pulp exhibits itself in the form of very transparent wide and flat cells.

It is of great interest sometimes to know whether wood pulp is present and how much has been used in the manufacture of the paper. In order to ascertain this a reagent composed of a mixture of hydrochloric acid and phloroglucine dissolved in alcohol is used. The existence of wood is at once revealed by a rose color. According to the intensity of such color as compared with that of tests made previously it will be possible to determine the quantity of the wood pulp that enters into the composition of the paper.

In order to ascertain the quantity of materials that have been added to the pulp to give the paper body the ashes due to the combustion of the paper are analyzed. In some badly prepared papers there sometimes remains a certain quantity of free acids that are detrimental to their preparation. The presence of these is ascertained by making a very liquid pulp with distilled water and acting upon it with Congo red, which becomes blue under the influence of free acids.

In industries that employ sized paper, it is necessary to know the composition of the materials that have been used for the sizing (gelatine, fecula, or resin). The presence of fecula is revealed by means of a very dark solution of iodine which produces a blue color. In order to see whether there is any resin in the sample it is only necessary to let a drop of ether fall upon it, when there is immediately formed an aureole bounded by a dull circle. To ascertain the presence of gelatine the paper is boiled with water, and the pulp is filtered and the filtrate treated with tannin. The precipitate that forms is leather.

In order to ascertain the degree of sizing of a paper a very ingenious method is employed. The sheet is arranged upon an inclined plane, and, by means of a

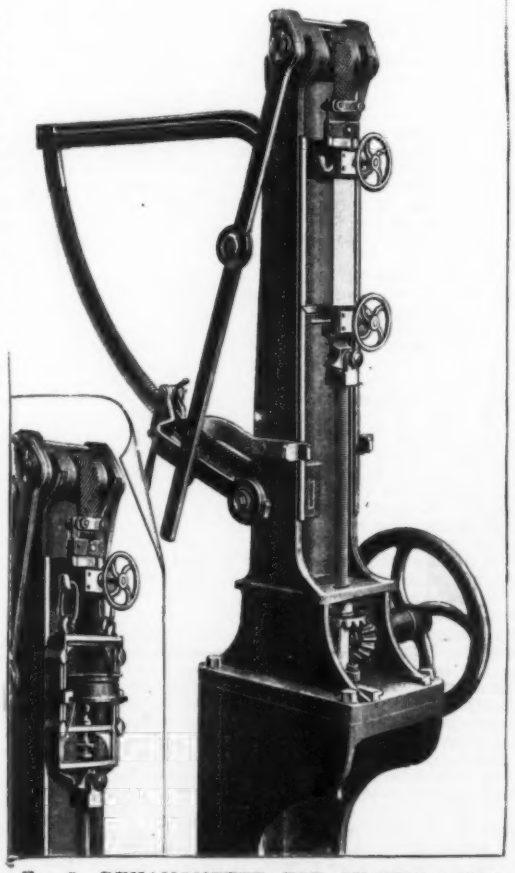


FIG. 3.—DYNAMOMETER FOR SHOWING THE RESISTANCE OF PAPER TO RUPTURE.

drop-counter, small quantities of chloride of iron are allowed to fall upon the upper surface of the specimen. The solution of iron in flowing leaves a series of lines upon the paper, which is afterward allowed to dry. The sheet is then turned over, and the same operation is performed with tannin upon the under

surface in forming lines at right angles with the first. If the paper is badly sized, there form spots of ink due to a mixture of the two liquids at the points of intersection of the lines. If, on the contrary, the sizing is perfect, no mixture and consequently no ink spots will be formed. According to the blackness of the latter the sizing leaves more or less to be desired.

In order to ascertain the power of absorption of blotting paper there is employed a small apparatus (Fig. 2) consisting of a trough filled with water. A crosspiece supports a series of graduated scales against which specimens of the paper may be secured. Before beginning the experiment the hour is marked. After this the collection of bands is allowed to graze the surface of the water for ten minutes, and the height of absorption of the liquid by the paper is noted. Blotting papers differ greatly from each other. Thus, in the same space of time, the water will rise 2.1 inches in one specimen and 3.5 in another. It is very important to manufacturers of paper to know the "conditioning" of the pulp that they employ, that is to say, to know the quantity of water contained in the materials that serve for its composition. Samples are taken from the bales received by the manufacturer and are submitted to the action of heat in the driers that we have already described in an article upon the conditioning of silk. These tests are made in the bureau that the Chamber of Commerce possesses on Rue de Viannes, and that are accessible to the public. Accurate information as to the respective qualities of the samples may be obtained by any one upon the payment of a small sum of money.—For the above details and the accompanying engravings we are indebted to La Nature.

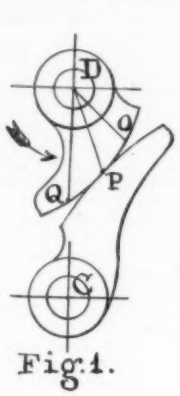


Fig. 1.

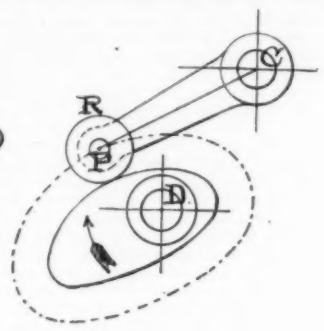


Fig. 2.

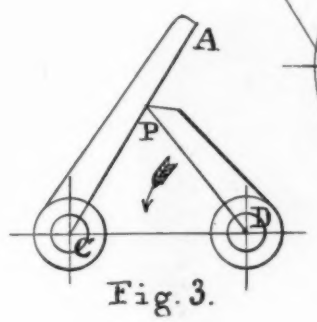


Fig. 3.

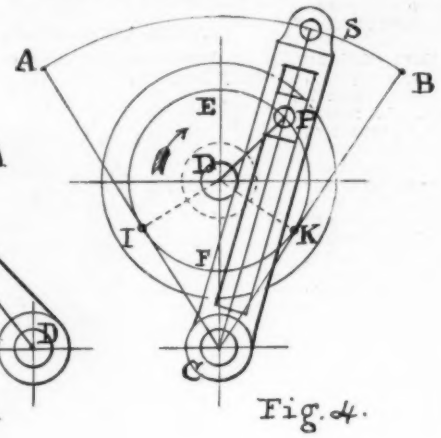


Fig. 4.

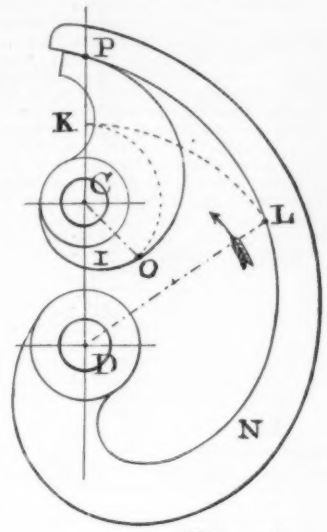


Fig. 10.

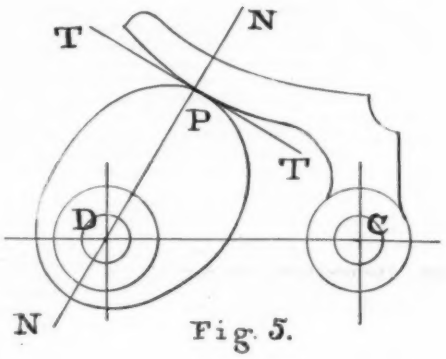


Fig. 5.

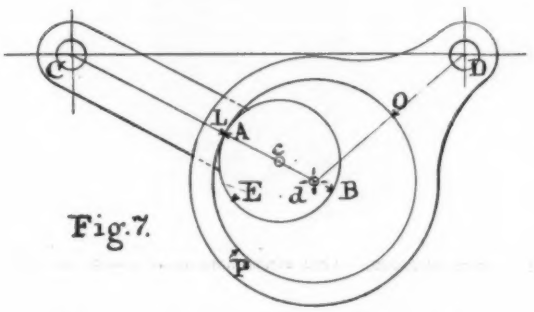


Fig. 7.

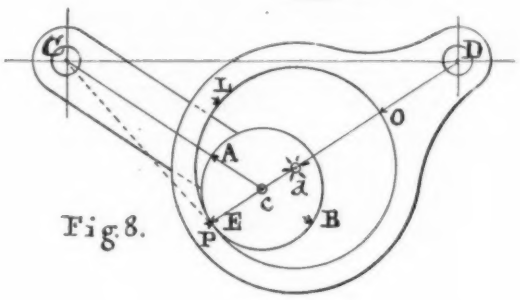


Fig. 8.

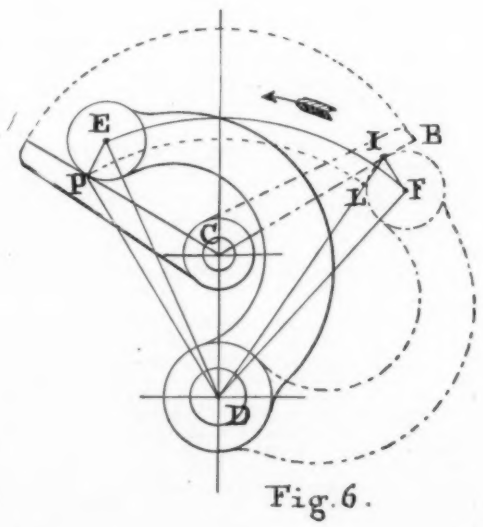


Fig. 6.

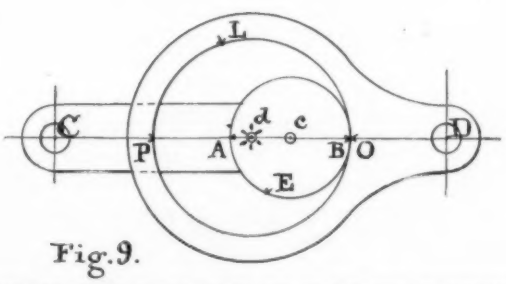


Fig. 9.

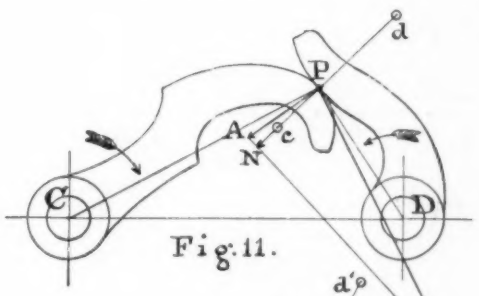


Fig. 11.

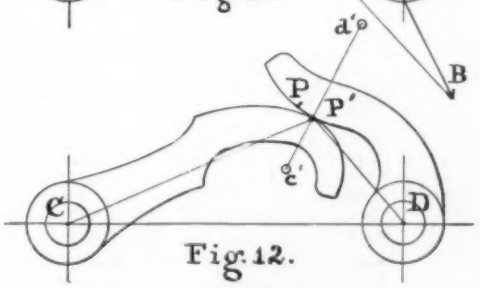


Fig. 12.

COMPULSORY ROTATION, OR POSITIVE DRIVING.

COMPULSORY ROTATION OR POSITIVE DRIVING.

By Prof. C. W. MACCORD, Sc.D.

LET the two curved pieces *C A*, *D B*, Fig. 1, turn about fixed centers at *C* and *D*, and let *P* be the point of contact. Also let *O*, *P*, *Q*, be consecutive radii of *D B*; then if that piece be turned to the left, as indicated by the arrow, the radius *D Q* being greater than *D P*, it will push the follower *A C* before it, and compel it to rotate. But if the motion of the driver be reversed, then since the succeeding radius *D O* is less than the present one *D P*, the piece *D B* will fall away from *C A*, and the latter will not be compelled to turn. This is substantially the argument of Prof. Willis ("Principles of Mechanism," ed. 1870, p. 68), the curves used in his illustration being portions of ellipses. In this case the contact radius of the follower will vary as the motion progresses. But a little farther on (p. 170, id.) Prof. Willis uses the same argument in the case of a cam like that shown in full lines in Fig. 2, which, rotating about the fixed center *D*, causes the lever *P C* to move about *C* through the intervention of the roller *R*. Clearly the motion of the lever is the same as that which would be produced by a cam like that shown in dotted lines, acting against the point *P*, the center of the roller. In this case the radius of contact *P C* of the follower is constant; but since these are the only instances given by Prof. Willis the inference is at least plausible that in his mind it was necessary for the radius of contact of a driving curve to be on the increase, in order to compel rotation of the follower.

In cases like these, and possibly in the majority of practical cases, the contact radius of the driver *will* be on the increase, no doubt; but it does not follow that this is the essential condition of compulsory rotation in contact motions. In Fig. 3, for instance, the contact radius is plainly constant. This, of course, is in this form not practical, since the contact point will continually scrape the acting face of the follower. This difficulty is entirely obviated by the device shown in Fig. 4, as familiar to our readers as it was to Prof. Willis, who describes and illustrates it under the name of "the pin and slit" ("Principles of Mechanism," pp. 165, 175). In this case the driving curve is reduced to a point (the center of the crank-pin *P*), and the follower is the center line of the slot, which in the figure is straight; but a different velocity ratio may be obtained by making it curved, as Prof. Willis first suggested in his discussion of this combination.

Now when *D P* in Fig. 3 becomes perpendicular to *C A*, its driving action will cease, the motion of *P* being then exactly in the direction *A C*; and if the motion be continued, *P* will fall away from *A C*, and contact will cease. Nor does Fig. 4 present an exceptional case; for the action is there practically transferred to the sides of the slot, the right-hand side being effective while the pin *P* traverses the arc *I E K*, and the left-hand side during the completion of the revolution; so that the vibration is continuously maintained, the lever pausing for an instant only when the center line of the slot reaches either of the extreme positions *C A*, *C B*, when it is tangent at *I* and *K* to the path of the crank-pin. At those instants, the situation is precisely similar to that shown in Fig. 5, in which *T T* is the common tangent, and *N N* is the common normal, to the two curves in contact at *P*. This illustration is borrowed from Prof. Barr, to whom is due the credit of enunciating this proposition: *The condition of compulsory rotation is that the common normal shall not pass through either of the fixed centers of rotation.* In Fig. 5 the normal passes through *D*; and if *D* be the driver, the motion of *P* is wholly tangential, while if *C* be the driver, it is impossible for it to turn to the left, since the normal component of the motion of *P* is in the direction *P D*.

Having thus been shown that my previous opinion was erroneous, I set about devising a combination in which compulsory rotation should be produced while the contact radius of the driver was on the decrease instead of on the increase. The result of this effort is shown in Fig. 6, in which *D* is the fixed center of the driver, whose acting face is a circle whose center is *F*. The acting face of the follower is the radial line *C B*, tangent to the driver at *I*, so that *D I* is the contact radius. When *F* has moved to *E*, *C B* will have the position *C A*, tangent to the driver at *P*; and setting off on *D I* the distance *D L* equal to *D P*, it is clear that the contact radius of the driver has during the movement decreased by the amount *I L*.

The difference between the initial and the final values of the contact radius, though not great, is at least palpable; but it is much greater in the combination illustrated in Figs. 7, 8, and 9, devised by Mr. Rudolph Vuilleumier, a member of the present junior class at the Stevens Institute of Technology. Here the small circle whose center is *c* and diameter is *A B* turns about the fixed center *C*, and is internally tangent to the larger circle whose center is *d*, diameter *P O*; which turns about the fixed center *D*. In Fig. 7, the common normal passes through *C*; in Fig. 8, it passes through

D; and in neither of these positions can there be, theoretically, any transmission of motion from one piece to the other, no matter which may be taken as the driver. But if in Fig. 8 we move *C c* a trifle to the left and *D d* to the right, so as to allow *P* to move a little beyond *E*, it will be evident that, continuing to turn the right-hand piece in the direction of the hands of a clock, the left-hand piece will be driven in the opposite direction, the theoretical limit being reached when the pieces are in the position shown in Fig. 9; the total decrease in the contact radius of the driver between the two limits being equal to *P O* the diameter of the larger circle.

If when in this last position we take *C c* for the driver, and reverse the motion, the small circle will drive the larger, the contact radius decreasing from the length *C O* in Fig. 9 to the length *C P* in Fig. 8. And another peculiar feature of the action of the model of this combination, which at first sight seems contradictory, or at least is unexpected, is this; if the two pieces when in the position shown in Fig. 8, be so manipulated that *P* passes a trifle *below E*, and then *D d* be turned counter-clockwise, *C c* will be driven *in the same direction*, so that *A* and *L* will approach each other, the tendency being to reach the limiting position shown in Fig. 7.

This model, then, illustrates the three limiting phases, in one of which the common normal passes through one of the fixed centers, in the second through the other, and in the third through both. But it will not escape observation, that an enormous amount of sliding is involved in its action, which, in passing from the position of Fig. 8 to that of Fig. 9, is equal to the difference between the semi-circumference of the larger circle and the arc *E B* of the smaller one. This, however, is not due to the fact that the contact radius of the driver is on the decrease; as Mr. Vuilleumier has conclusively shown by means of the combination shown in Fig. 10, where there is no sliding at all.

The acting curves, *P O I*, *P L N*, are logarithmic spirals of the same obliquity; of which *C* and *D* are the poles, and the point of contact is at *P* on the prolongation of *D C*. If now we describe about *C* an arc *O K* through any point *O* taken at pleasure on the inner curve, and about *D* another arc with radius *D K*, cutting the outer curve in *L*, we shall have

$$D L - C O = C D = P D - P C;$$

consequently the spiral arcs *P O*, *P L*, are equal to each other, and, when the outer curve drives in the direction of the arrow, the points *L* and *O* will come together at *K*. That is to say, the point of contact will always lie upon the line of centers, which is the condition of rolling contact.

In the last four figures the acting face of the driver *D* is a concave curve, while that of the follower *C* is a convex one. But this is not an essential feature, as may be seen by regarding the action between the tooth of one spur-wheel and that of another, when both are constructed on the epicycloidal system. In this case the concave flank of the driver's tooth acts against the convex face of the follower's tooth during the approaching action; after that, the convex face of the driver's tooth acts against the concave flank of the followers; still throughout the whole engagement the contact radius of the driver is on the increase.

Again, it is obvious that in Fig. 6 the radial line *C B* might be replaced by a convex curve, and the circular acting face of the driver by an elliptical or other convex curve without affecting the argument. The fixed centers, *C*, *D*, are in Fig. 6 on the same side of the point of contact: but convex curves may also be used when these centers are on opposite sides of the point of contact, while compulsory rotation will still be caused while the driving contact radius is on the decrease. This is shown in Figs. 11 and 12, in which *D* and *C* are the fixed centers of the driver and the follower respectively. In Fig. 11, *P* is the point of contact of the two curves, of which the acting faces (within the range here discussed) are circular arcs, of which *d* and *c* are the centers. Assigning to the point *P* of the driver a motion *P A*, perpendicular to *P D* the contact radius; the normal component of this is *P N*, which is also the normal component of the motion of the point *P* of the follower. But the direction of the motion of this last-named point must be perpendicular to *P C*, so that its velocity will be *P B*, limited by the prolongation of *A N;* this shows that the directions of the rotations will be as indicated by the arrows. Now when the pieces have moved to the positions shown in Fig. 12, the centers *c*, *d*, will be found at *c'*, *d'*, thus determining the point of contact *P'* in that phase of the movement; and it is obvious on inspection that *D P'* is less than *D P;* so that in this case also compulsory rotation is caused while the contact radius of the driver is on the decrease.

THE SALE OF MINIATURE MODEL LOCOMOTIVES.

MODEL locomotives complete, or parts with which such locomotives may be built, are nowadays sold in such numbers that the production constitutes a branch of manufacture by itself, says The American Exporter. The locomotives are made in four standard sizes, of which the three smaller are those more commonly sold. The largest of all is as likely to be sold for business uses as for the purposes of a model.

No. 1, the smallest of them, has a length over all, engine and tank, of 39 inches, runs on a track of 3½ inches gage, and is of three-eighths of a horse power. It is sold for $100. No. 2 is of half a horse power and 58 inches over all, runs on a track of 5¼ inches gage, and sells for $150. No. 3 is of one horse power, and 78 inches over all, runs on a 7-inch track, and sells for $250. No. 4, of two and a half horse power, is 108 inches in length over all, runs on a track of 12 inches gage, and is sold for $500.

These are all copies of a heavy passenger locomotive of modern type, and made to scale. They are complete working locomotives in miniature. There is also made a model locomotive engine of the type used on the elevated railroads in this city. It is 26 inches in length over all and sells for $50.

The model locomotive, handsomely nickel-plated, is sometimes sold to be placed in the office of some railroad company. Inventors buy these locomotives upon which to display to the best advantage new and improved appliances; and sometimes for the better illustration of improvements in track equipments, as in frogs and switches, the model locomotive is shown in motion. Technical schools buy them to illustrate the valve motions. Youths about to take up the study of mechanical engineering buy them, as do young men already engaged in such study or just graduated from it, as a practical aid in their pursuit of knowledge of the mechanisms involved. Such engines are sold to be given away, as for instance by some generous giver to a boy or young man who was interested in locomotives. Such an engine as the No. 3 has been put to actual use in the operation of a railroad in a back yard and hauls little cars carrying children. In a large room in a house, here in the city, there has been put down a miniature railroad system, tracks and switches and so on, upon which a model locomotive is operated, in this case, however, not for amusement but for purposes of experiment and observation; this installation having been made, as all changes in it from time to time are, by the experimenter.

SEAMLESS, FLEXIBLE, METAL TUBING.

IN Germany a new form of flexible tubing has recently been introduced, which bids fair to supersede

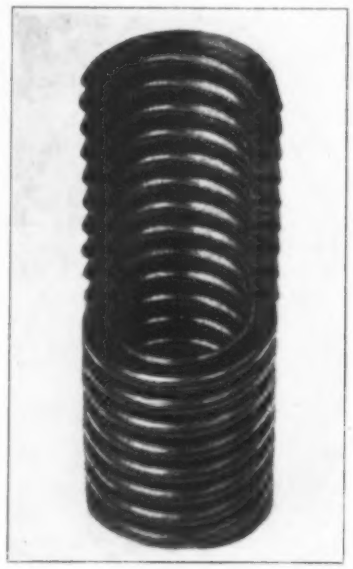


FIG. 1.—SECTION THROUGH THE SPIRALLY-WOUND ROLL.

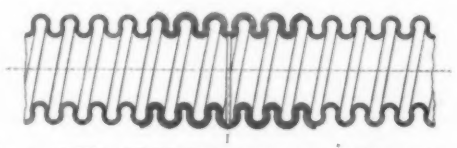


FIG. 2.—TWO FLEXIBLE TUBES COUPLED BY A CENTRAL SLEEVE.

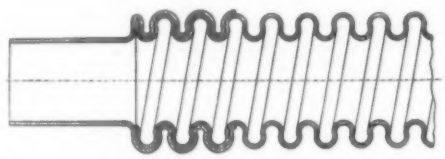


FIG. 3.—FLEXIBLE TUBE PROVIDED WITH AN END-SLEEVE.

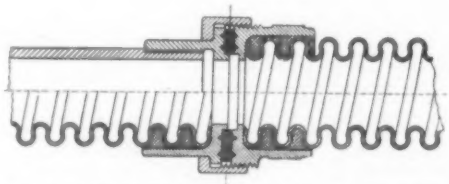


FIG. 4.—COUPLING FOR FLEXIBLE STEAM-PIPES.

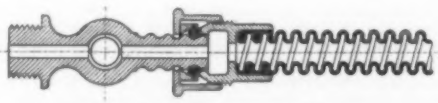


FIG. 5.—GAS-PIPE COUPLING.

rubber or hemp hose. According to Prometheus, the new tubing is perfectly water-tight and is seamlessly drawn from a spirally-wound roll. The peculiar form of this roll imparts to the tube great elasticity and flexibility. Great resistibility to breakage and wear are said to be characteristic of the new product.

The tubing is made in various lengths, diameters, and strengths; the pressure which can be withstood varies from 6 to 20 atmospheres; the flexibility increases with the length. The tubing is admirably adapted for the making of garden and fire hose, of fluid conveyers for heating and cooling purposes, of speaking-tubes, air brake pipes, steam pipes, and the like. Flexible seamless tubing of aluminium should be of considerable service in chemical works and in distilleries. The coupling of tubes can be accomplished in various ways. Two water or compressed-air pipes, for example, can be connected with a hose by a brass sleeve which screws and is soldered upon the ends of the pipe to be joined. A flexible tube can be coupled to a faucet by means of an end sleeve, as shown in Fig. 3. For flexible steam pipes, the form of coupling illustrated in Fig. 4 is employed, the sleeve being composed of bronze and soldered to the tube in order to fill the intermediate spaces.

THE USE OF BLAST-FURNACE GASES IN GAS ENGINES.

DURING the past year all the difficulties in the use of blast-furnace gases have successfully been overcome, and it is interesting to consider the rapid progress that has been made in this important development of metallurgical practice. The question was first taken up by Mr. B. H. Thwaite in 1894, and a 15 horse power engine, worked by blast-furnace gas purified by his apparatus, was set to work at Wishaw, in Scotland, in February, 1895. Since that date numerous small motors have been in operation in this country using purified blast-furnace gas driving machinery and dynamos. In the development of large motors and in their adaptation to blowing engines Belgium has taken the lead. In May, 1898, Mr. A. Greiner, of the Cockerill Company, described a 200 horse power engine in successful use at his works. The results attained stimulated experiment in Germany and in Luxemburg. The Cockerill Company, however, continued to take the initiative by starting, on November 2, 1899, the largest gas engine ever built. On May 9, 1900, Mr. Greiner described the engine to the Iron and Steel Institute, and gave the results of six months' working. This was the first gas engine to run the blowing engine of its own furnace. Results of tests of this gas engine, by Prof. Hubert, of Liége, are given in an appendix to an exhaustive paper on power gas and large gas engines, read by Mr. H. A. Humphrey before the Institution of Mechanical Engineers on December 14, 1900. The engine was designed by Mr. Delamare-Debouteville, and built by the Cockerill Company. It is a single cylinder, 600 horse power engine, working on the Otto cycle, and direct coupled to a double-acting blowing cylinder. The large engine and blower shown by the Cockerill Company at the Paris Exposition was a duplicate of the one under discussion. It was rated at 700 horse power on blast-furnace gas, at 800 horse power on producer gas, and at 1,000 horse power on illuminating gas. In an exhaustive paper on the subject, published by Prof. Joseph W. Richards in the current number of the Journal of the Franklin Institute of Philadelphia, the following list of blast-furnace gas engines now in operation is given:

	No.	Horse Power.
Seraing, Belgium	4	500
Differdingen, Luxemburg	4	500
Hoerde, Westphalia	2	600
	2	1,000
Friedenshütte, Silesia	2	200
	2	300
Oberhausen	1	600
Dudelingen	2	600
	2	1,000
Kneutingen	2	500
Roechling	1	200
	2	600
Ruhrort	1	500
Barrow, England	—	1,000
Toula, near Moscow	3	600
	3	200
Island of Elba	—	1,000

The Cockerill Company is now constructing for the Roechling Iron Works, in Lorraine, three 1,200 horse power gas engines. They are double-cylinder tandem engines directly attached by a tail rod to the blowing cylinder. The Cockerill Company and Mr. Delamare-Debouteville have now decided to build engines of 2,500 horse power. They will have two tandem cylinders on each side of the dynamo, giving four cylinders per engine. They are designed for a central electric station.

In view of the remarkable results already attained, there can be no doubt that during the next few years the design and erection of large central power stations for the generation and distribution of electric energy in bulk will be one of the most important problems with which engineers will have to deal. The new stations will be larger than any now existing, and every possible effort will be made to reach an unprecedented degree of economy in the production of power. Mr. Humphrey's paper strongly urges the claims of the gas engine to rank as a rival of the steam engine for large power units. The results of a trial of a 400 horse power Crossley gas engine carried out by Mr. Humphrey are certainly most satisfactory, while its capability for continuous work has been shown at Messrs. Brunner, Mond & Company's works at Winnington, Cheshire, where it is used for their electrolytic plant. The employment of gas engines in large central station work is, however, still very limited, for out of the total of seven central stations where gas motors are used, the largest has only an aggregate of 650 horse power, while the largest unit is of only 200 horse power. The use of the waste gases from blast furnaces renders it possible to have a supply of cheap fuel. This result can also, according to Mr. Humphrey, be attained by the use of a Mond producer plant, which is suitable for converting cheap bituminous fuels into suitable gas for gas engines, and at the same time permits of the recovery of the ammonia from the coal as a by-product.

The great industrial revolution which is imminent in the economical utilization of blast-furnace gases is best shown by the careful calculations made by Prof. Richards of the results that would be attained by the application of this improvement to American blast-furnace practice. As an illustration of average practice he takes the figures from a blast-furnace plant in Eastern Pennsylvania, which is making in three furnaces

2,600 tons of pig iron per week. The composition of the gas by volume is as follows:

CO_2	CO	H	N
9	27	1.8	62.8

The pig iron produced daily is 370 tons; the fuel used per 100 kilogrammes of pig iron, 100.0 kilogrammes; carbon in fuel, 82.9 kilogrammes; carbon in flux, 4.6 kilogrammes; carbon in the iron, 3.1 kilogrammes; efficiency of stoves, 60 per cent; efficiency of boilers and engines, 4.5 per cent; pressure of blast, 1.3 kilogrammes per square centimeter (20 pounds per square inch); and temperature of blast, 555 deg. C.

With these conditions the calculations are as follows:

Calorific power of gas per cubic meter, 873 calories; volume of gas per 100 kilogrammes of pig iron, 434.7 cubic meters; calorific effect of gas per 100 kilogrammes of iron, 379,490 calories; heat required to heat blast per 100 kilogrammes of iron, 90,500 calories; indicated horse power of engines for blast, 950 horse power; indicated horse power of engines for hoist, pumps, etc., per 100 tons of iron daily, 65 horse power.

From these calculations the following conclusions are arrived at:

	Calories.
Calorific effect of gases per 100 kg. of pig iron.....	379,490
Lost (10 per cent)..... 37,950	
For heating blast..... 90,500	
	128,450
Surplus for burning develops....	251,040
Surplus per 100 tons of pig iron daily	251,000,000

The horse power at 100 per cent efficiency would be 6,400; horse power with steam at 4½ per cent efficiency, 738; deficit of steam power per 100 tons of iron daily, 277 horse power; horse power with gas engines at 30 per cent efficiency, 4,920; surplus power with gas engines per 100 tons daily, 3,900 horse power; deficit of steam power per 370 tons daily, 1,025 horse power; surplus of gas engine power per 370 tons daily, 14,400 horse power.

It is an actual fact that at the works considered by Prof. Richards the three blast-furnaces are charged with 800 horse power, furnished to them by the boiler plants fired by coal. It is also a fact that nearly 10,000 horse power is raised for the rest of the plant by coal-fired boilers, and that all of this could be supplied by gas engines utilizing the blast-furnace gases. The saving in the coal bill alone would amount to at least £30,000 in one year. The gas-engine plant to accomplish this would cost £100,000. These calculations, based on average practice, bring out very clearly the great saving of power possible by the economical utilization of blast-furnace gases.—Nature.

ON THE NEED OF EDUCATION OF THE JUDGMENT IN DEALING WITH TECHNICAL MATTERS.*

Of all teachable things, the education of the judgment receives the least attention, while its importance is supreme. I do not know of a single university that has a chair of common sense, and in trying to reason out why this so important endowment is not taught I can think of but one reason, and that is the impossibility of finding a man to fill such a chair.

Men in all professions are therefore left to acquire this most important part of their education as they acquire practical experience, and in most cases with as little success.

It is an unfortunate condition with us that we are nearing the end of our work before we realize how important a factor judgment is in all questions of importance that come before us in our everyday experience.

Self-education in the matter of judgment is a life-long mental discipline. One of the most important points in this process is very difficult to deal with, for every time it comes up it involves us in an internal struggle which equally affects our vanity and our ease.

This point consists in the tendency to self-deception in regard to the result we wish for. For any one who is not brought daily to the necessity of self-correction in regard to this tendency, it is impossible to realize how all-powerful the tendency is, and how unconsciously we all yield to it. How eager we all are to seek for such evidence as may be in favor of what we want the result to be and to disregard any evidence pointing the other way. We receive as friendly that which agrees with our preconceived notions, and resist and dislike that which opposes them.

In fact, the inclinations we exhibit to receive and to act upon any report or opinion that harmonizes with our preconceived notions can be compared in degree only with the incredulity we entertain toward everything that opposes them. And all this goes on unconsciously, while we honestly believe that our judgment is entirely free and unbiased.

It is my purpose to try, in as simple and direct language as I am able to use, to point out some of the ways in which we fail to exhibit sound judgment in dealing with the engineering problems that confront us every day.

In my work, how do I suffer from lack of judgment on the part of myself and those connected with me, and how could much of that suffering be avoided, thereby reaching results with less waste of labor and time? This is an inquiry worth making, even if the answer be not quite satisfactory.

There is fast growing up a system which, if I understand the direction in which it is moving, proposes to dispense with the necessity for the exercise of judgment in dealing with everyday engineering problems. Young men without experience, and who have never had the chance to acquire an educated judgment, are, as a rule, put in charge of very important work, and a set of instructions is provided for their guidance, which instructions are supposed, if rightly carried out, to obviate the necessity for any exercise of judgment on the part of the person in charge.

Those of us who are carrying out large contracts with the government and with some public companies find it hardly possible to get anything decided by sound judgment based on experience. I have often tried to reason from my own experience with young inspectors of work, but that kind of reasoning is not now admissible. Printed instructions are produced, with the intimation that these must be adhered to in every particular, the inspector having no discretion in the matter. I have often traced these printed instructions back to their source, and found the author to be a man whom I would not like to trust with doing the work covered by them.

In mechanical engineering and kindred business, such as shipbuilding, the great bulk of the designing is done by the contractor, all working plans being prepared by him. He is also held responsible for the result; yet all his plans must be submitted to a young and, from the very nature of the case, inexperienced inspector, who, however clever he may be in solving theoretical questions relating to the device in question, has never had to make those things himself and to be responsible for their working after being made, and for their costing no more than he said they would cost before he began.

Now, the young inspector reads in his book of instructions, generally in a preface, that the object of printing these instructions is for the proper protection of the interests of the government.

In a decision by the Judge Advocate of the United States navy, I read the other day that the aim and intent of the wording of the specifications and contract for the building of a warship were solely to protect the interests of the government.

Now, my idea has always been that the object of the specifications and contract, when fully carried out, was to produce the best possible warship of the kind specified; that there were two parties to the contract, and that the interests of one needed protection just as much as the other. The language used in the decision mentioned shows how difficult it is for an inspector to use sound judgment, even if he has it at his command. When a plan is presented to him by which you propose to carry out the object of the specification, he looks at it with the distrusting notion in his mind that you have used what skill you possess to design this part of the work as cheaply as possible, and that it is his business to stand between you and the object of your desire; and he will not reason with you as to the why and wherefore of your design without putting you on the defensive in regard to your own character instead of that of your design. And when he has found out where he can add something to your design, to increase its cost without spoiling it, he is very likely to do so, as he thereby tickles his own vanity by impressing you with his power and cuts you out of doing the thing with the simplicity and economy that you were planning for.

This shows the need of an educated judgment on the part of such an inspector. And, of course, it might be the other way. The contractor, in making his design, may allow his self-interest to rob him of all sound judgment, and his desire for a simple and cheap device may lead him into making something that would not properly meet the requirements of his contract. What is needed is an honest endeavor on both sides to cultivate the growth of a sound judgment that can decide technical questions altogether apart from the personal interests of the parties.

In no question is sound judgment, based on long experience, more necessary than in the many disputes that arise regarding workmanship and material. Here, where an educated judgment is most required, we find that self-interest and hard and fast rules interfere most with its application. When I look back over the many battles I have had with inspectors who demanded their pound of flesh when it could not possibly be got without blood—sometimes all the judgment lacking on the one side, and sometimes on the other—I wonder why we should continue beating the air over questions that with the exercise of a small amount of sound judgment would never be raised.

A good many years ago, while in the casting yard one morning, I noticed a propeller casting, a solid cast wheel which had, as many of them are apt to have, some gas checks across the back. I did not consider that the small defect should be any reason for condemning the casting. That was my judgment. Perhaps I was assisted in forming this judgment by a strong desire to save the cost of another casting. When the superintending engineer of the company for which this wheel was made saw the casting he promptly condemned it, and no amount of reasoning on my part could alter his judgment. There being no desire on his part to help his judgment to concur with mine, he would take no chances with a wheel having any visible defect. And he believed that my opinion was formed entirely on self-interest, while his was founded on the high plane of engineering prudence.

In this particular case I thought it worth while to test the foundation upon which each of us based our judgment. So I said to him: "Your company pays for this wheel 9 cents per pound, and it costs my company 6 cents. If I make another we lose 3 cents per pound instead of making 3 cents per pound. Now, I think that I am right in claiming that the slight defect in this casting is no ground for condemnation, but in order to save actual loss your company can have the present wheel for 6 cents per pound."

"Well," said he, "now you're talking reasonably. I will see our people about it and let you know." Within an hour this wheel was accepted and went into service, and, so far as I know, had a long and useful life.

Now, I myself might have acted just as this engineer did, but the transaction illustrates how much we are all influenced by our own desires in these questions instead of by sound judgment, and how difficult it is to know when the decision is prompted by desire when we think we are exercising our judgment.

Our whole modern method of testing and inspecting materials is founded on the belief that the faculty of judgment in an inspector is a dangerous thing, and that all excuse for its cultivation must be eliminated from his mental stock in trade.

The other day I saw condemned and broken up a large bronze casting that had cost about $3,000 because the coupons or test pieces showed less tensile strength than the specifications required. The casting itself was perfectly sound and very tough; in fact, admirably suited for the purpose for which it was made, and not the slightest doubt of its character was expressed by any one who saw it. Yet, because the test piece was required to show 55,000 pounds tensile strength per sectional inch and broke at 44,000 pounds, a great deal of labor and costly material was deliberately destroyed, the inspector claiming he had no discretion, which means no judgment, to exercise; and, when the case was appealed to a higher authority, that authority, who could not see this good piece of work, entirely suited for its place in the structure and with ample margin of strength, simply sent to destruction with the careless remark, written officially from the other side of the country, that the requirements of the specifications must be fulfilled.

You must not understand me to mean that physical tests are not very important in deciding the quality of material, but when applied without judgment they may result in great waste of both labor and material, for they do not present the whole case, even as to the character of the material of which the test pieces themselves are made.

We often have plates of steel where the test pieces, cut directly from the plate, will give fine results, say 60,000 pounds tensile strength and elongation of 30 per cent in 8 inches, and will double over on themselves without sign of fracture, and yet the plate itself would break like glass in bending over a large radius.

I have cut test pieces right out of plates that would not bend at all, and the test pieces would double over on themselves without sign of fracture.

Not long ago I had a plate of government material to bend on the press for a keel plate, but the plate broke hopelessly in bending. There was no other plate to replace it of material that had been tested and accepted for government use, and the inspector would not allow any other plate to be taken for the purpose.

I, however, took a plate of steel for merchant work and bent it to the required form with no sign of fracture. We cut a test piece out of the broken plate, right by the fracture, and it showed 61,000 pounds tensile strength and 28 per cent elongation, and bent over on itself without fracture. Then we took a test piece out of the plate that had been successfully bent to the desired form and showed 62,000 pounds tensile strength and 22 per cent elongation, and it broke before it had completely bent over on itself.

Therefore the perfectly bent plate was not allowed to be used because the test piece did not meet requirements.

Here the test intended to guard against the use of unsuited material resulted in preventing the use of eminently suitable material; not because of anything wrong in the test, but through the lack of judgment in applying the result of the test to the desired end.

I could multiply cases—they are of almost everyday occurrence—where the lack of judgment in regard to the value of tests results in needless loss and in great delay in carrying out work.

Lack of judgment is often manifested in a demand for unreasonably strict compliance with a specification that makes no allowance for ordinary imperfections in all products, even of the most skillful workmen.

Not many days ago I had such a case to deal with in building a small marine boiler for the Treasury Department under a very strict specification. I found that it would make better work to weld the plate forming the sides of the combustion chamber, as the seam was in the way of the stays as shown in the drawing. The inspector thought so, too, so the plate was welded; but the slight waste in heating resulted in the plate being one-thirty-second of an inch thin at the weld. I did not foresee this, but the inspector discovered that the plate was slightly thinner at the weld, and, the specification requiring a certain thickness of plate, the work was suspended until a decision should come from Washington. The decision came in due course and in the usual form, instructing the inspector to require the work according to the specifications.

Now, if this had been made as specified, with a riveted joint, its strength would have been, say, 67 per cent of the plate, while the welded joint gave 92 per cent. Yet, notwithstanding all this, the work was condemned and thrown away.

This loss did not result from any desire on the part of the inspector or his superior to cause loss to the contractor, but simply from a failure on their part to apply sound judgment to the question before them.

A plan or specification is an instrument to be used for the production of a certain piece of engineering work. The thing produced is the only reason for the instrument being brought into existence, and when once the instrument has served its purpose its value disappears.

Yet engineers engaged to apply this instrument are, as a rule (especially the young men), more intent on applying the instrument than in considering what the instrument may be doing, forgetting that the instrument can of itself produce nothing, and that if not applied with judgment it will produce only such things as the man that made the instrument could himself produce. But, when applied with the correcting power of sound judgment, acquired in the production of similar things with other instruments, it becomes pliable in the hand of a master, and the result is the combined power of the instrument with the trained judgment of him that applies it.

All technical men engaged in producing tangible things out of ideas expressed in our defective language, interpreted by some one perhaps better acquainted with words than with things, and whose judgment has not been matured by any intimate knowledge of the actual work that the specification he is to enforce is intended to produce, feel how hard it is to get their position understood, and how often they must do things against their better judgment for fear it may be thought that their own interest, and not their experience, is the foundation on which their judgment rests.

*By George W. Dickie, Member of the Technical Society of the Pacific Coast. Read before the Society, December 7, 1900.

THE PANHARD-LEVASSOR AUTOMOBILE.

THE well-known Panhard-Levassor automobile, which has figured so prominently in French races, has a rectangular frame made of U-shape wood covered with iron, or of wood alone. The corners are protected by metallic angle pieces, and the longitudinal members with sheet steel. At about the height of the rear wheels the frame is strengthened by a metal cross-rod. Somewhat further to the front is a second cross-rod which serves as a brace for the ends of an intermediate or inner frame resting on the forward portion of the main frame. This intermediate or inner frame carries the driving-mechanism. In the front the motor is arranged, which is inclosed in a detachable casing provided with several doors; near the middle of the carriage is a dust-proof casing containing part of the gearing. Both the motor and gear-casing are securely bolted to the intermediate frame.

FIG. 1.—THE FAMOUS 12 H. P. PANHARD-LEVASSOR CARRIAGE FORMERLY OWNED BY RENÉ DE KNYFF.

One of the novel features of the carriage is the peculiar disposition of the shaft of the differential gear. The shaft in question consists of several parts. The main part projects from its casing and carries at its end a clutch, which serves the purpose of driving the smaller portions of the shaft to which the sprockets of the chain driving-gear are keyed. By reason of this arrangement it is not necessary to remove the chains and the casing of the sprocket-shaft-members in order to detach the differential gear-casing. The bolts are taken out; and the entire gear-casing falls out of the frame.

As a general rule the motor is mounted in front of the carriage. The burner, the intake-pipe, and the igniter are located to the right; the devices for the regulation of the explosive mixture and the discharge of the gases to the left. The motor is set in motion by a hand-wheel. The motor-shaft traverses the greater portion of the carriage. When it leaves the motor the shaft splits into two branches. Of these branches the one nearer the motor carries a hollow fly-wheel in which a friction-cone mounted on the other branch is received. In order that the branches may constantly preserve their relative positions, the friction-cone is provided with a finger-like point. The motor-shaft passes through the lower portion of the rectangular gear-casing, which is divided into two compartments, containing respectively the speed-changing and reversing gears. The motor-shaft carries a number of movable gear-wheels which are of various diameters, and which when respectively thrown into engagement with one of an equal number of fixed gear-wheels, drive the carriage at a speed varying with the diameter of the gear-wheel in use at the time. At the end of the upper shaft a bevel-gear wheel is mounted which engages one of two rectangularly-arranged bevel-gear wheels, including the differential gear. The direction of the vehicle's motion is changed by throwing the first-mentioned gear-wheel into engagement with one of the other two gear-wheels. On the left-hand side of the shaft of the differential gear is a brake-drum. Sprockets and chains transmit the power developed by the motor to the driving-wheels of the carriage. Adjacent to the sprocket-wheels and rigidly connected therewith are brake-drums formed with grooves for the reception of brake-straps.

In the rearmost part of the carriage the muffle and the water-reservoir are arranged. The parts for steering the vehicle and for controlling the operative mechanism are located on the right-hand side of the carriage. Instead of chains, gearing or levers are employed in the steering mechanism. At the driver's right hand are three levers and before him two or three pedals—all controlling the driving mechanism.

The vertical two-cylinder motor (Fig. 4) of the carriage, contrary to the usual custom, has the admission and exhaust valves placed very near each other. The admission-valves are located on the same level as the hot-air valve, *N*, and the exhaust-valves between *S* and *E*.

The supply-pipe which overtops the cylinder conducts the explosive mixture to a suction-pipe, whence it is led by branches to the two admission-valves. The valve, *N*, by means of which heated air is conducted to the motor, constitutes the end of a stout preheating pipe which passes above the burner on its way to the carbureter, so that the air is heated. Near the point of its entrance into the carbureter the pipe is provided with an opening through which cold air is supplied.

Beneath the burner are two small cylinders vertically disposed and closed at their upper ends and provided at their lower ends with two pipes. Through these pipes oil, supplied by lubricating apparatus carried on the dashboard, trickles and lubricates the cylinder of the motor. On the opposite side of the motor the nuts, *S*, are seen, by means of which a strap is clamped upon two closures. These closures cover openings above the exhaust-valves; and by means of these openings the valves can be readily reached. Beneath the coiled spring, *R*, of the exhaust-valve is a second somewhat finer coiled spring which serves the purpose of maintaining a permanent connection of the valve-stem with the controlling-rod, *D*. The stem and rod are so joined that the rod, *D*, when the governor moves the arm, *F*, toward the cylinder, can move downward without changing the position of the valve-stem.

On the driving-shaft of the motor a gear is keyed, meshing with a second gear, *T*, of twice the diameter. The shaft on which the gear, *T*, is mounted also carries the two arms for the alternate opening of the exhaust-valves. Water enters the motor at *J* and leaves it at the upper part. The two piston-rod heads are secured to the same part of the crank-pin and separated by a counterpoise, which to a certain extent influences the piston-rods.

In the two or four cylinder Panhard motors the

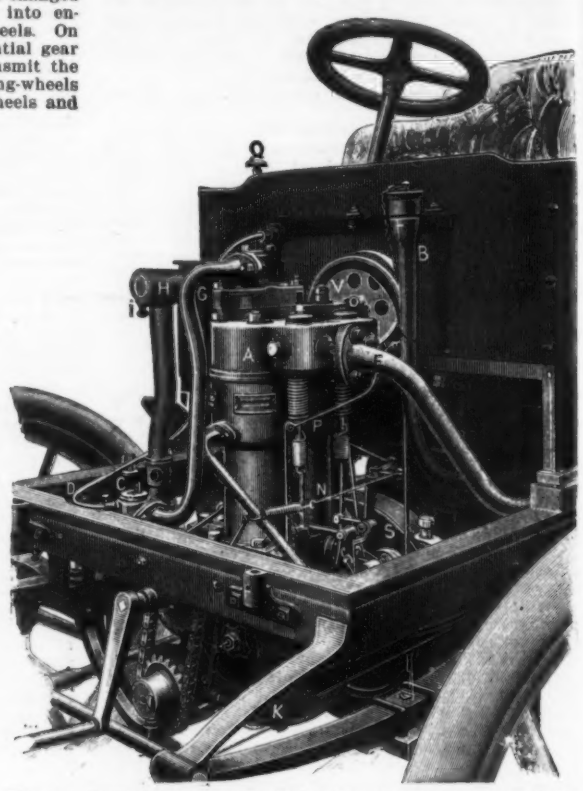


FIG. 3.—THE FRONT PORTION OF A 6 H. P. CARRIAGE.

A, cylinder; *B*, opening for supplying the cooling apparatus with water; *C*, carbureter; *D*, benzin-supply pipe; *E*, exhaust pipe; *G*, intake pipe; *H*, preheating pipe; *i*, valve; *K*, gear-casing of the auxiliary shaft; *M*, crank; *N*, device for reducing the speed of motor; *P*, device for increasing the speed of motor; *Q*, hand-lubricator; *S*, fly-wheel; *V*, disk of the Dubrulle lubricator.

FIG. 2.—SIX HORSE POWER PANHARD-LEVASSOR CARRIAGE.

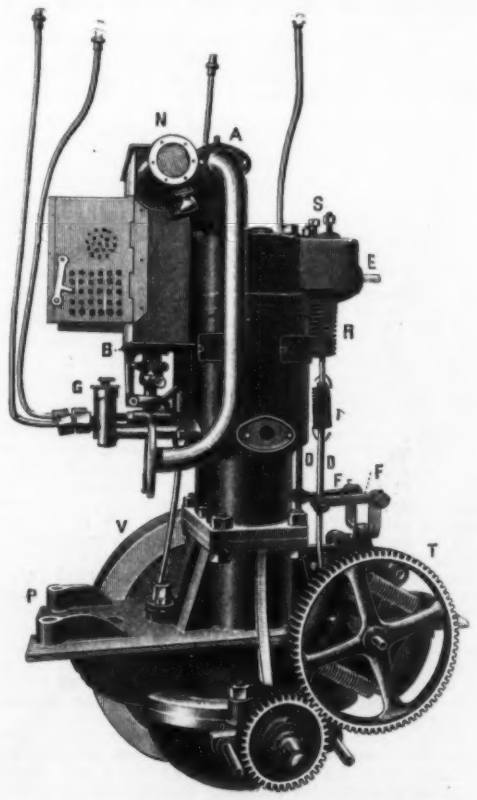


FIG. 4.—TWO CYLINDER, 4 H. P. PANHARD-LEVASSOR MOTOR.

intake; *B*, burner-lantern; *D D*, controlling rods of exhaust valves; *E*, exhaust; *F F*, lever-arms which operate the exhaust-valves; *G*, cylinder-lubricator; *J*, entrance of water-supply pipe; *N*, hot-air valve; *O*, centrifugal governor; *P*, motor-frame; *R*, coiled spring of the exhaust-valve; *r*, small coiled spring connecting the rod, *D*, and the exhaust-valve stem; *S*, opening for removing the exhaust-valve; *V*, fly-wheel.

gases are exploded by platinum ignition-tubes heated by burners. Benzin is fed to the flame by the natural pressure due to the difference in level of the benzin-reservoir and burner.

The motor is cooled by water constantly circulated by a centrifugal pump frictionally driven by the fly-wheel. The water flows from a tank through a three-way valve and is forced by the pump into the lower part of the motor. After emerging from the upper part of the motor, the water returns to the tank. The steam which may be generated in the tank is led off by a pipe which discharges beneath the rear portion of the vehicle. Without exception the radiators are placed between the motor and the tank.

The power-transmission gearing of the Panhard-Levassor carriage, as we already know, is inclosed in a removable dust-proof casing. In the cover of the casing one or more openings are formed, through which the inner parts can be examined and lubricated. The lower portion of the casing is provided with a drain-hole. The casing is divided into two unequal compartments. The first and longer of these compartments contains the speed-changing gear; the second the reversing-gear. In the first compartment there are, furthermore, two shafts, the lower of which carries the fly-wheel. That portion of the shaft which lies within the carriage is square in cross-section, so that the four movable gears corresponding with the changes in speed can be carried along by the shaft. On the upper, round shaft are four gear-wheels and a bevel-gear wheel. The movement of the motor is transmitted to the bevel-gear with a speed which varies with the diameter of the gear-wheel in mesh at the moment.

Although this system of power transmission certainly has the merit of being noiseless, it has been applied only to carriages of moderate speed.

The operative mechanism of the carriage is controlled by three levers and three pedals. The levers (Fig. 8) form a sheaf, as it were, convergent toward the carriage. By means of the first lever the brakes of the rear wheels are set; by means of the second lever the speed is changed, and by means of the third lever the direction of the carriage's motion is changed. All three levers can be shifted along sectors and held in notches by pawls. The second lever, *N*, moves along an inner sector provided with four notches corresponding with the four changes of speed. The sector of the third lever, *O*, is shorter and has three notches by which the key, *S*, is received. When the lever is held in the central notch, the carriage is brought to a standstill. When the lever is shifted into one of the other two notches the carriage is driven either backward or forward.

Of the three pedals, the first is used for the purpose of throwing the motor into and out of gear with the driving-wheels. The second pedal controls the brake of the differential gear. The third pedal is connected with a rod leading to the governor.

The moving parts are all oiled by lubricators. In the new four-cylinder vehicle the lubricators are all arranged on the dashboard, so that they are always under the eye of the chauffeur. The pivots of the levers and similar parts are oiled by hand. The differential gear, although practically running in oil, must be well lubricated after 400 or 500 miles have been covered.

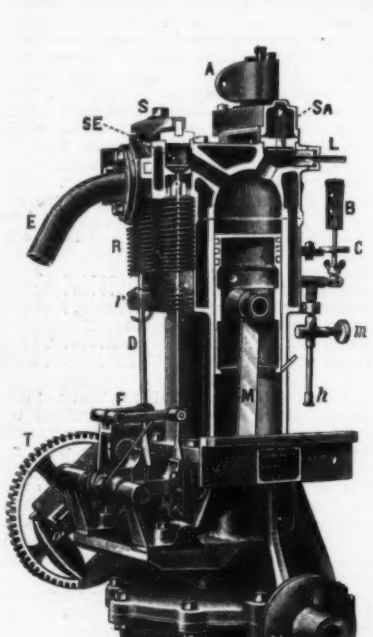


FIG. 5.—PANHARD-LEVASSOR MOTOR.

A, intake; *B*, burner; *D*, controlling-rod of the exhaust-valves; *E*, exhaust-pipe; *F*, lever-arms for operating the rod, *D*; *h*, drain pipe, used when cleaning the burner; *L*, platinum ignition tube; *m*, valve; *M*, piston-rod; *N*, disk on which fly-wheel is mounted; *O*, rods provided with friction rollers and serving the purpose of raising the controlling-rods; *O'*, centrifugal governor; *R*, coiled spring of the exhaust valve; *r*, small coiled spring connecting the controlling-rods and exhaust-valve stems; *S*, strap for holding the closure of the valve casing in place; *S A*, intake valve; *S E*, exhaust-valve; *T*, large gear for reducing the speed of motor-shaft.

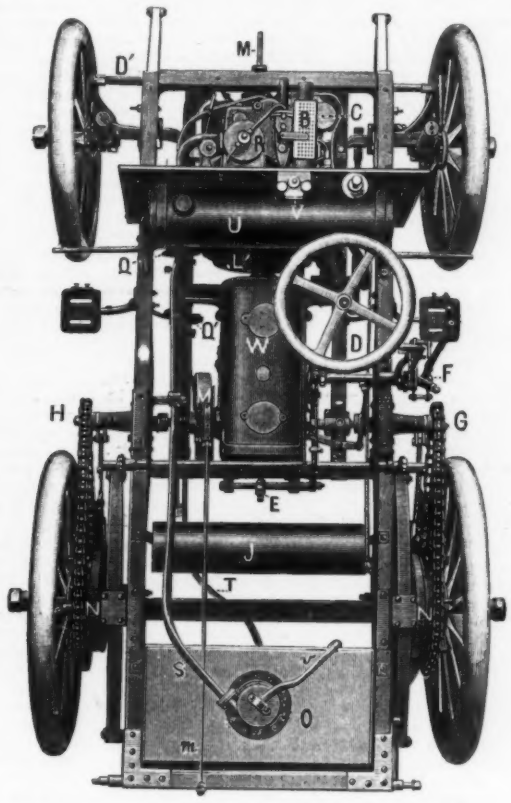


FIG. 6.—TOP VIEW OF 6 H. P. PANHARD-LEVASSOR CARRIAGE.

B, burner; *C*, carbureter; *D*, steering-wheel; *D'*, rods operating front wheels; *E*, clutch; *F*, controlling-levers; *G H*, sprocket-wheels; *J*, exhaust muffle; *L'*, friction clutch; *M*, crank; *M* (white), brake-strap of differential gear; *m*, rod for operating the differential brake; *N N*, brake-drums of the driving-wheels; *O*, water tank; *Q Q'*, pump; *U*, benzine reservoir; *V*, lubricator; *v*, pipe for leading off steam from water tank.

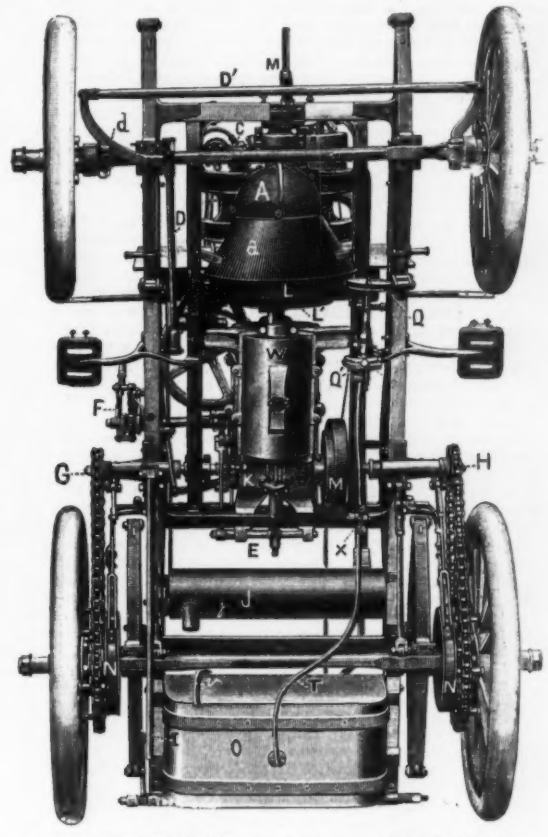


FIG. 7.—BOTTOM VIEW OF A 6 H. P. PANHARD-LEVASSOR CARRIAGE.

A, frame of the motor; *a*, sheet metal protective hood; *C*, carbureter; *D d D'*, parts of the steering-gear; *E*, clutch; *G H*, sprockets; *J*, exhaust muffle; *j*, pipe for conducting gases to the open air; *K*, rod for controlling the reversing-gear; *L L'*, fly-wheel and friction-clutch; *M*, crank; *M* (white), brake-strap of the differential gear; *N N*, brakes of the driving-wheels; *O*, water-tank; *Q Q'*, pump and its wheel; *T*, water-supply pipe for pump; *v*, pipe for leading off the steam of the water-tank; *X*, three-way valve.

INHABITED SAFETY VALVES.

THE Locomotive, published by the Hartford Steam Boiler Inspection and Insurance Company, says, in a recent issue: "Overalls, monkey-wrenches, hammers, loose rivets and all sorts of things are sometimes found in boilers by our inspectors, as we have frequently related in The Locomotive. It may be mentioned, too, that pop safety valves also frequently serve as receptacles for unexpected things, though in this case the foreign articles are usually deposited there by our friends of the world of fur and feathers. Pop valves, in fact, are growing to be quite fashionable places for birds' nests, and it is not uncommon to find that the English sparrow has utilized such a valve as a hatchery and nursery. When a number of boilers

FIG. 8.—THE THREE LEVERS.

M, lever for throwing in the brakes of the driving-wheels; *m'*, pawl-lever to release the brake-lever, *M*; *N*, speed-changing lever; *O*, reversing-lever; *O'*, handle to remove the pawl, *S*, from the sector; *P*, hook for the stay connection.

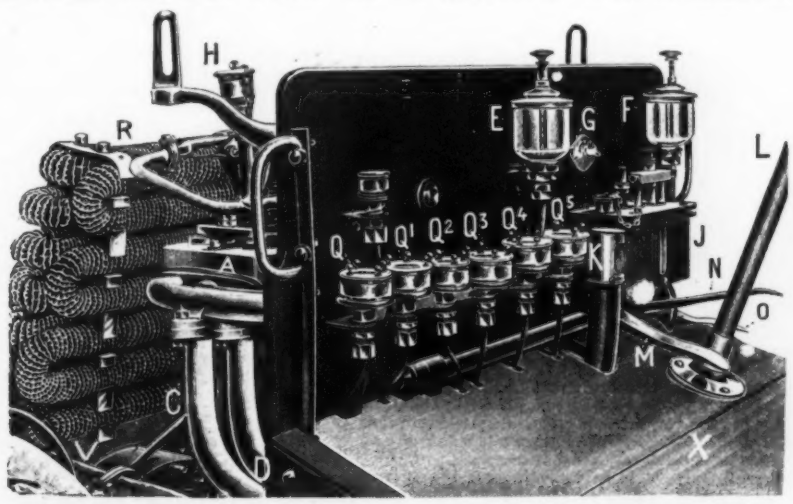


FIG. 9.—CONTROLLING APPARATUS OF A FOUR-CYLINDER RACER.

A, two of the cylinders; *C D*, exhaust pipes of the four cylinders; *E*, hand-lubricator; *F*, auxiliary hand-lubricator of the Dubrulle apparatus; *G*, lever controlling the auxiliary air-supply pipe; *H*, feed-opening of the water-circulating apparatus; *J*, Dubrulle oiler; *K*, cold-air intake; *L*, steering-wheel post; *M*, pedal for throwing out the motor; *N*, pedal controlling the differential brake; *O*, pedal controlling the accelerator; *P*, pump-lubricator; *Q*, lubricator for the gear-clutch; Q^1, lubricator for the left bearing of differential-gear shaft; Q^2, lubricator for the central bearing of the upper shaft; Q^3, lubricator for the first bearing of the upper shaft; Q^4, lubricator for the right bearing of the shaft of the differential-gear; Q^5, lubricator for the reversing-gear; *R*, cooling-coil; *X*, hinged floor of the carriage-body.

are always run together as a single battery, it usually happens that there are slight differences in the blowing points of the different valves, so that under ordinary circumstances only one or two of the valves blow, relief enough being obtained in this way to keep the pressure below the blowing points of the others. An enterprising sparrow may then rear her brood in a lazy way, by building her nest where the temperature is just right. All she has to do, then, is to turn the eggs from day to day, and the rest of the time she can go to picnics or attend circuses or grand opera, according to her taste, with the full knowledge that the proper temperature is being maintained at home. She has, in fact, quarters that are up to date. They are heated by steam, and the boiler is cared for by her janitor, the engineer, who is paid for this service by the otherwise soulless corporation that owns her flat.

"Occasionally, however, she and her little family are evicted—literally 'fired out.' We hear, in the larger world, of the janitor giving a tenant 'a good blowing up,' and this is what happens, from time to time, to our little bird families, through no fault of their own. One of the inspectors from the Hartford office of this company recently had a pop valve blown in his presence, so that he might be satisfied that it was in good condition. A straight escape pipe led from the valve out through the side of the building, and when the valve blew, out through this pipe came nests and other things galore, and immediately there were flats to rent in that valve and pipe.

"Squirrels, too, are coming to regard pop valves with increasing favor, both as nesting places and as safe-deposit vaults for the storage of nuts. A few days ago one of the Hartford Company's inspectors found a pop valve that was filled almost solid full of hickory nuts by some industrious squirrel. It is not likely that these nuts would have prevented the valve from blowing, and yet, when considered from an engineering standpoint, they could not be regarded as an improvement to it. A pop valve loaded with hickory nuts and provided with a straight, horizontal escape-pipe, would, when it blew, be likely to make the neighbors think the Spanish war was still with us!"

CONTEMPORARY ELECTRICAL SCIENCE.*

METHOD OF TRANSVERSE CURRENTS.—An interesting investigation of the theory and practice of the transverse current method of determining resistances has been made by J. Stark. The main question raised is as to whether two currents traversing a conductor in two different directions between electrodes situated upon equipotential surfaces with respect to each other can be considered as simply superimposed. This is obviously only the case as long as the resistivity is independent of the current density. It is also necessary that the electrodes do not produce a polarization. The author considers a cylindrical conductor, carrying a current along its axis, and having point electrodes applied to it at opposite ends of a diameter of a cross section. He shows that a simple superposition of currents holds good even if there are internal electric forces, provided their effect is axial. In practice, it is almost impossible to place the electrodes in an equipotential surface, especially in gases. In the latter, the resistance does not correspond with the potential gradient owing to the internal charges. There is less conductivity near the cathode owing to the greater speed of the negative ions. This is a well-known fact in connection with incandescent lamps, where transverse currents are almost inevitable.—J. Stark, Ann. der Physik, No. 11, 1900.

ELECTRO-CAPILLARITY OF MIXTURES.—M. Gouy has studied the effect of adding a small quantity of an "active" salt (in the capillary sense) to a solution of a comparatively inactive salt. Such active salts are chiefly iodides, bromides, platino-cyanides, sulpho-cyanates, and sulpho-carbonates. They produce, even in very dilute solutions, a considerable depression of the maximum deviation. If 0.01 gramme-equivalent of such a salt is added to a liter of a normal solution of an inactive salt, the mixed solution behaves practically as if it contained only the former salt. In spite of the great difference of concentration, the active salt practically supplants the inactive. The effect of adding the active body, say an iodide, to a less active one, say a bromide, is always to reduce the surface tension. Bromide added in small quantities to iodide produces no effect, but in some cases the depression of the maximum is increased by the presence of an inactive body. The author supposes that there exists an elective action at the mercury surface which produces an accumulation of the anions of the active body rather than of the others. If the active anions are few the state of equilibrium takes some time to establish itself, and we then have a case of electro-capillary viscosity.—Gouy, Comptes Rendus, November 19, 1900.

ELECTRIC DISPERSION IN CONFINED AIR.—Elster and Geitel showed some time ago that the dissipation of an electric charge in air is probably due to the action of ions, as in all other known cases. H. Geitel has studied this question by observing the dispersion in an hermetically-sealed vessel. The first result obtained was that the dissipation gradually increases in the course of several days. This goes to disprove the assumption that a given volume of air is only capable of discharging a limited quantity of electricity. The author attributes the increase to the gradual laying of the dust, which, as we know now, hinders the dissipation instead of promoting it. Allowing for that disturbing factor, it appears that the rate of discharge is constant in time, and not only that, but the quantity dispersed in a given time is independent of the value and the sign of the potential, as long as that value is comprised between 240 volts and 80 volts, at all events. This is just as if in an ordinary circuit the current depended upon the resistance only, and not upon the E.M.F., and resembles the case of a clock, which goes at a certain rate whatever the tension of the spring. The nearest allied phenomenon is that described by J. J. Thomson and E. Rutherford, who found that in artificial anomalously conducting air the current intensity tends toward a maximum with increasing potential. The author supposes that a definite number of ions is regenerated in unit of time in the confined air-space.—H. Geitel, Physikal Zeitschr., November 24, 1900.

GEOGRAPHICAL ELEMENTS OF ELECTRIC DISPERSION.—In the course of a protracted cruise, J. Elster has taken the opportunity of studying the dispersion of an electric charge under a great variety of circumstances, and has arrived at some important conclusions. Out of 390 measurements 102 were made on Capri, 49 at Lugano, 58 on Spitzbergen, 14 in Algiers, and 23 at Tromsö. In every case it was noticed that an increase in the humidity of the air brought about a decided decrease in the rate of dissipation. Such a decrease is also observed in ascending above sea-level. Thus at Lugano, which is 900 feet above sea-level, the positive dispersion coefficient was 3.33 and the negative coefficient 2.17. At Maloja (5,700 feet), three days later, the coefficients were 8.33 and 9.44 respectively, showing in this case a greater negative dispersion. At the Casa Inglese on Etna, the positive coefficient was 3.19, and the negative 7.53. The unipolar character of the discharge becomes very marked at some high altitudes. Thus the ratio between the two coefficients was found to be 14.8 on the summit of Monte Solaro (Capri) and 16.0 on the Piz Languard, near Pontresina. At the same level the difference in the polarity becomes the stronger the higher the latitude. As a rule, the rate of discharge of negative electricity is double that of the positive electricity. A few cases of unipolar discharge were noticed on the Mediterranean stations, but these were probably due to the ionization of the air by the breakers on the beach.—J. Elster, Physikal Zeitschr., November 24, 1900.

ELECTROLYTIC EFFECTS OF SECONDARY CURRENTS.—It is often assumed that the evolution of explosive gas at the submerged electrodes of the secondary circuit of an induction coil is due to the alternate formation of hydrogen and oxygen at both electrodes in accordance with the change in the direction of the induced current. But K. R. Johnson proves that while gas is evolved at both electrodes by the current induced at break, no gas is evolved by the current induced at make. He further found that the gas evolved at both electrodes is explosive, and that therefore both oxygen and hydrogen were evolved at both electrodes. The electrodes were of Wollaston pattern—platinum wires fused into thin glass tubes—and the electrolyte was either acidulated water or a solution of sugar and calcium nitrate. The experiment affords an elegant proof of the fact that the secondary current at break is alternating. The author also found an interesting analogy between the amount of gas evolved and the maximum spark-length in air. Both are inversely proportional to the square root of the capacity of the primary condenser, provided that capacity is considerably above the capacity required for suppressing the primary break-spark.—K. R. Johnson, Ann. Physik, No. 12, 1900.

* Compiled by E. E. Fournier d'Albe in The Electrician.

THE ENGINEERING WORKS OF THE SUEZ CANAL.

IT is a surprising fact that in spite of the unique position among ship canals of that cut across the Isthmus of Suez, there is no satisfactory official or semi-official account in English of its engineering features, says The Engineering Record. Nearly 33 years ago Sir William Denison read a paper on the subject before the Institution of Civil Engineers, and from that time until March, 1900, English professional literature has been nearly barren of contributions on the subject. On that date a short history of the engineering works on the canal, written by Sir Charles Hartley, was presented by his colleague on the International Consultative Commission of the Suez Canal Company, Sir John Wolfe Barry. The author has been connected with the enterprise almost from its inception, and speaks as an authority on the subject. The paper has been printed by the Institution, and the following article is merely a summary of some of its most interesting portions.

In November, 1854, Ferdinand de Lesseps obtained a concession for a waterway from sea to sea without locks, and in October, 1855, an International Consultative Commission, selected from among the most celebrated hydraulic engineers in Europe, was appointed to report on the scheme. The final report of the Commission was accepted by the Khedive in June, 1856. It adopted a direct route through the Isthmus from Suez to the Mediterranean. It was decided that there should be no embankments where the canal passed through the Bitter Lakes. It expressed the opinion that locks at the two extremities of the canal would not be necessary, as the lakes would have the effect of deadening the tidal currents. It stipulated that the depth of the canal should be 26¼ feet and wide enough not only to allow two vessels to pass each other, but to give room for a third line of vessels which might, from any cause, stop on the way; and it was therefore recommended that the canal, between the Red Sea and the Bitter Lakes, should have a width of 210 feet at the bottom, and of 320 feet at the top; and that the channel between the Bitter Lakes and the Mediterranean should be cut to a width of 144 feet at the bottom, and to 262 feet at the top; and lastly, the Consultative Commission decided on the plan of running out jetties directly seaward at Port Said to protect the entrance. The ultimate choice of the entrance (thanks to the representations of Mr. Larousse, hydrographer of the French navy), although necessarily involving the construction of a considerably longer artificial waterway across the Isthmus, was based on the important consideration that a depth of 26¼ feet was found at a distance of less than 2 miles from Port Said, whereas at the proposed easterly entrance, near the old Pelusiac mouth of the Nile, the 26¼-foot contour was fully 5 miles from shore. At Suez the construction of a single jetty was deemed sufficient, and no difference of opinion existed as to the disposition of the necessary inner harbor works at each end of the canal. The lengths of the west and east jetties at Port Said are 9,800 feet and 6,000 feet respectively. The width between them at their origin is 4,200 feet, and their distance apart at the end of the east jetty is 2,300 feet. The width and depth of channel alongside the west jetty are 330 and 30 feet respectively.

The construction of the canal was greatly facilitated by the existence of four dried-up depressions which were formerly and have again become lakes of considerable area, namely, the two Ballah Lakes, the Great and Small Bitter Lakes and Lake Timsah. These low-lying regions have an aggregate length of 27 miles. Excavation was required, however, throughout the Ballah Lakes, Lake Timsah and the Small Bitter Lake, as well as along a portion of the Great Lake; and, consequently, it was only for a length of about 8 miles of the latter, where the natural depth exceeded that of the canal, that no excavation was necessary. The distances between Port Said and these lakes are as follows:

	Nautical Miles.
Port Said to north end of Lake Ballah	26
Port Said to south end of Lake Ballah	30
Port Said to north end of Lake Timsah	41
Port Said to south end of Lake Timsah	44
Port Said to north end of the Bitter Lakes	53
Port Said to south end of the Bitter Lakes	73

The total distance from Port Said to Suez, Port Thewfik, is 88 nautical miles (100 English miles) or 160 kilometers.

The only serious obstacles to be overcome were at the summit of the work, where the hills crossing the canal vary from 30 to 60 feet above the sea-level over a length of 6 miles, and at the deep cutting between Lake Timsah and the Great Bitter Lake. From Port Said to Kantara, a distance of 24 miles, the canal passes through a shallow lagoon which covers an area of nearly 1,000 square miles.

The character of the soil, which is mainly composed of pure sand and sandy-clay lying above and below a nearly continuous stratum of hard clay, intersected here and there by bands of hard and soft rock, was favorable to rapid execution; and the construction at Port Said and Suez of commodious basins for shipping, and of the long sea jetties, composed of "pierres-perdues" and artificial blocks of concrete, thrown down at random to a height of 4 feet above the waterline, presented no serious engineering difficulties. In short, the canal works in general were of a very simple nature; but, being of vast magnitude, involving, as originally proposed, the removal of 60,000,000 cubic meters of dry earthwork and 56,000,000 cubic meters of earthwork under water, and being situated in a country entirely destitute of fresh water, a specially well-conceived organization was imperatively required to bring the colossal work to a successful issue.

On April 25, 1859, De Lesseps turned the first spadeful of sand at Port Said. In March, 1861, not a fiftieth part of the earthwork of the canal proper had been removed; a condition of affairs due to financial difficulties, a great paucity of laborers, the difficulty of providing them with fresh water, the faulty construction and inefficiency of the steam-dredges then employed, and the impossibility of keeping open the newly-dredged entrance channel at Port Said before it was protected by the jetties.

As the work progressed, these difficulties were gradually surmounted, thanks chiefly to the skill and resource of Voisin Bey, the first engineer-in-chief, and his able assistant engineers, Messrs. Laroche, Larousse and Gioia; and to the provision by M. Lavalley, the contractor, of a large fleet of powerful dredging machines, by means of which the dredged material, carried by long and high projecting shoots, was rapidly delivered on either bank of the canal at some distance from the slopes of the cuttings without the intervention of barges. These and other mechanical appliances had the effect of reducing by three-fourths the number of workmen needed to open the canal by the time originally estimated; while the completion of the fresh-water canal in 1863 relieved the company of the enormous expense of supplying the workpeople with water brought from the Nile on camel-back.

The financial difficulties were overcome (1) by decreasing the width of the bottom of the canal to 72 feet, less than one-half the width recommended by the International Consultative Commission, it having been found soon after the works were begun that the cost of the work had been greatly under-estimated; (2) by virtually increasing the original capital of £8,000,000 to £17,120,000, thanks to the Emperor Napoleon's award of £3,800,000 and to subsequent loans amounting to £5,320,000. As some compensation for the greatly reduced area of the canal, "gares" or sidings were provided at every 5 or 6 miles between Port Said and Lake Timsah to allow vessels to bring up either for the purpose of passing each other, or to moor for the night.

In April, 1867, water from the Mediterranean was let into the marshy bed of Lake Timsah, but it was not till March, 1869, that it was allowed to flow into the nearly dry salt-encrusted basins of the Bitter Lakes. On November 17, 1869, the Suez Canal was inaugurated with great pomp and thrown open to navigation. On December 31, forty-four days after the opening of the canal, when in several places the depth was less than 20 feet over a width of 60 feet, the cost price was stated in the "Bulletin decadaire," No. 22, as follows:

General expenses of the constitution of the company, cost of negotiation, commission, stamps and expenses as to shares	£561,380
Cost of management for 11 years	567,300
Interest during construction, including sinking fund	3,316,520
Service of health, telegraph, domain and transit, 1868-1869	533,539
Cost of construction, including sinking fund to pay for materials	11,654,223
Total	£16,632,953

According to the official statistics, made up to De-

cember 31, 1882, the dredging and excavation work for the maintenance of the canal and basins from November, 1869, up to and including 1882, had been 13,600,000 cubic meters (exclusive of 1,800,000 cubic meters for enlargements), and according to the annual statistics of the company for 1897 the amount of dredging required for maintenance pure and simple from 1875 to 1897, both inclusive, had been 31,064,839 cubic meters. When it is considered that the cost of dredging averages upward of 1 shilling per cubic meter, the heavy annual charge incurred for maintenance becomes at once apparent.

Owing to the increased delay in the passage of steamers through the canal after 1876, and to the startling augmentation of traffic after 1872, resulting principally from the adoption of iron steamers in the Red Sea route to the Far East, and from the great economy of fuel effected by the employment of screw-propellers worked by triple-expansion engines, an economy in transport which was unforeseen when the concessions for the canal were obtained, it was universally admitted in 1883 that a radical plan of improvement was imperatively demanded.

This opinion caused the Directors to announce in 1884 that a second International Consultative Commission, consisting of eight Frenchmen, eight Englishmen and six members of other nationalities had been appointed to study the best means to be employed either to enlarge the present canal sufficiently or to construct a second canal alongside the existing one, with the object of eventually providing ample accommodation for a traffic exceeding 10,000,000 tons a year. The Consultative Commission met in Paris, and held three sittings in the latter part of June, 1884, when, after discussing two alternative schemes presented by the engineer-in-chief of the canal, M. Lemasson (one for the enlargement of the existing channel, and the other for an independent parallel channel), it was decided that eight members of the Commission should act as a Sub-Commission and visit Egypt; in order to make such observations and investigations on the spot as would ultimately enable the Commission to arrive at a final decision. Inasmuch as M. Lemasson's project for the enlargement of the existing waterway was accepted with but few modifications by the Sub-Commission, and eventually by the Directors of the Canal, the main features of that scheme should now be described.

In explaining the details of this project the execution of which he recommended should be divided into three stages, M. Lemasson contended that the waterway should be wide enough for two steamers to pass each other in motion without danger of collision; and to accomplish this he was of the opinion that there should be a space equal to two clear beams between them, and an interval of 40 feet between their outer sides and the lines of buoys. This meant a channel—taking 48 feet as a maximum beam—about 230 feet broad at the bottom, which he considered would be sufficient for the long straight reach south of Port Said; while for the Suez end and for the curves he proposed to increase the breadth to 262 feet. The total cost, including plant, was estimated at £8,118,000 if the depth were kept at 26¼ feet, or £9,750,000 if increased to 29½ feet. The cost of a parallel canal having a depth of 29½ feet was estimated at £11,150,000, but this merely served for the construction of a new channel of the same width as the existing one, and no allowance was made for sidings, nor was any sum included to represent the capitalized value of the great increase of the working expenses which the execution of a second canal would undoubtedly entail.

The result of the visit of the Sub-Committee to the canal and its interesting experiments on the restriction of the speed of vessels in the canal by the reduced waterway was the passage of the following resolutions by the full Commission on February 11, 1885:

"Concerning the choice of methods to be adopted for the enlargement of the waterway, the Commission gives unqualified preference to the system of a pure and simple enlargement of the canal, from the Mediterranean to the Red Sea.

"As to the dimensions of the enlarged canal:

"1. As to the depth, the Commission is of opinion that the project for the works and estimate of cost should comprise a final deepening of the canal to a depth of 29 feet 6 inches below the level of low water of ordinary spring tides at every point; but at the same time the Commission thinks that the program for the successive execution of the work should be fixed with the object of first obtaining a depth of 27 feet 10 inches; the complementary deepening of 1 foot 7 inches being the last phase of the execution of the projected improvement.

"2. As to the widths of the canal and the easing of the curves, the Commission is of the opinion that the canal should have the following widths at the depth of 26 feet 3 inches below the level of low water of ordinary spring tides, that is:

"A. Along the portion of the canal between Port Said and the Bitter Lakes: In straight reaches, a width of 213 feet. In curves of more than 8,200 feet radius, a width of 246 feet, measured at the apex of the curve adjusted gently to the normal width of the canal; and lastly, in curves of 8,200 feet and less radius, a width at the apex of at least 262 feet.

"B. Along the portion of the canal between the Great Bitter Lakes and Suez: In straight reaches, a width of 246 feet. In the curves, a width of 262 feet at the apex. As to the curve in the Timsah Lake, to increase its radius to 4,100 feet, and to begin its correction without loss of time.

"3. As to the harbor of Port Said, the Commission approves of the reduction of the width of the Asiatic island between the coaling dock and the Ismail dock, and of the rectification of the curve at the first mile post to a radius of 9,843 feet.

"Concerning the typical sections of the canal, the Commission is of opinion that it is necessary to include the protection of the canal banks against erosion in the project for the completion of the canal. The Commission, moreover, thinks that this protection of the banks is not indispensable in the first instance, and is only necessary throughout the Menzaleh and Ballah Lakes and between the small Bitter Lakes and Suez. Among the different types of protection works already employed, the Commission would prefer (wherever the nature of the ground allows its application) a stone pitching in mortar laid at as steep a slope as possible in favorable ground, reaching down to 6 feet 6 inches below the level of low water of ordinary spring tides, resting on a benching of a width just sufficient to insure a solid base for the work, and rising to a height of about 3 feet 3 inches above the level of high water of ordinary spring tides.

"Lastly, the Commission thinks that the typical sections drawn up by the engineer-in-chief of the company in conformity with the above indications should be definitely accepted."

These recommendations were signed by all the members of the Consultative Commission, and were accepted soon afterward by the president and directors of the Suez Canal Company.

It was considered that the enlargement pure and simple of the canal was incontestably the best solution, because an enlargement could speedily be made of the same width as the existing sidings, so as to provide passing places in the canal from end to end; a disposition which would realize almost the same conditions of passage as could be afforded by two separate canals, while at the same time—owing to the larger sectional area of a widened canal—vessels would be able to accomplish their transit with more speed and safety than by means of two separate channels, each having the same area as the existing canal. Moreover, by eventually increasing the width threefold in the straight reaches and fourfold in the curves, steamers in motion would be able to pass each other in safety, at a reduced speed, at any part of the canal; and, finally, because the cost and maintenance of a double canal of the same dimensions as the existing waterway would be very much greater than the cost and maintenance of a single canal of the dimensions proposed by the engineer-in-chief.

Long discussions took place at the final sittings of the Sub-Commission as to the relative values of widths as compared with depths of channel, owing to the circumstance that, according to the estimates of M. Lemasson, the adoption of a depth of 29½ feet instead of 26¼ feet would involve an extra outlay of £1,500,000, unless the bottom widths were considerably reduced in order to meet the cost of the extra depth proposed. With regard to the merits of this important question there was a marked difference of opinion; certain members of the Sub-Commission attaching the utmost importance to a notable increase of depth, even at the expense of a diminished width, and other members holding to the opinion that any additional depth was unnecessary. The two English delegates and Mr. James Laing, who took a leading part in the discussion on this important matter, expressed their opinions strongly in the former sense, and endeavored, but with only partial success, to convince their dissenting colleagues of the supreme importance of affording a free passage to vessels of a draught of 27 feet with 2¼ feet under the keel; while, on the contrary, certain other members of the Commission contended that there was no necessity to provide vessels with a greater draught than 24 feet 6 inches, with 1½ feet under the keel.

The first phase of the enlargement was completed in December, 1898, from a width of 72 feet to 121 feet 4 inches, and from a depth of 26 feet 3 inches to 27 feet 10 inches, or 12 years from the commencement of the work; a much longer time than was originally specified, owing to financial considerations and to the circumstance that the increased capacity of the canal for traffic, owing to its illumination by electricity, rendered it unadvisable, in the opinion of the directors, to carry on the work as expeditiously as was at first intended.

The execution of the work comprised in the first stage calls for no special remark, neither, for want of space, can anything be said here concerning the comparatively unimportant modifications which were recommended by the Consultative Commission during the progress of the work. It should be recorded, however, (1) that the type of revetments recommended by the Consultative Commission of 1885 have, as a rule, been adopted in practice, the precise locality and details of the work in connection with the nature of the ground to be dealt with being left to the discretion and appreciation of the engineers-in-chief; (2) that the leisurely manner in which the improvements contemplated by the directors in 1885 have been carried out up to this time has had the beneficial effect of reducing to a minimum the many inconveniences to traffic which are inseparable from the execution of extensive dredging and revetting operations in a crowded channel; and (3) that it is a matter of congratulation, thanks to the skill and forethought of the engineers of the company, that the actual excavation and dredging (21,638,700 cubic meters) removed during the first stage of the work has only been 2½ per cent in excess of the quantity originally estimated.

The advantage to trade by increasing the limit of the draught of steamers on April 15, 1890, from 24 feet 6 inches to 25 feet 7 inches is proved by the fact that, while in 1891 the percentage of vessels passing through the canal drawing from 24 feet 6 inches to 25 feet 7 inches was only 3.2 per cent compared with the total number, the proportion in 1897 amounted to 13.1 per cent.

For many years past the dimensions, especially the beam of steamers, have been greatly augmented. Thus, since 1893, a large number of cargo vessels, with lengths of 460 feet to over 520 feet, and beams from 60 to 70 feet, have passed through the canal for the first time, whereas in 1885 the maximum length and beam of trading vessels frequenting the canal did not exceed 460 feet and 48 feet respectively. In view of this remarkable augmentation of the dimensions of trading ships in so short a time, the directors, in 1897, decided on the creation of nine new sidings, 49 feet wide and 2,460 feet in length, in order to facilitate the passage through the canal of steamers of the greatest beam. They are now completed to their full width and give great satisfaction to the navigation.

A constantly growing traffic will probably at no distant period demand a reconsideration of the question of practically carrying out the recommendations of the Consultative Commission of 1884-85 with regard to the further widening of the canal, after taking into account the course of proceeding suggested by the light of experience. Meanwhile it seems highly desirable, in the interest of commerce, that a sufficient depth should be provided, as soon as practicable, for vessels of a draught of 27 feet 10 inches instead of limiting it to 25 feet 7 inches, as at present.

In October, 1894, the Consultative Commission decided on recommending the directors of the company to arrange for the maintenance, by means of dredging, of a channel 10 meters deep and 200 meters wide at the sea entrance to Port Said. Although this has not yet been attained, strenuous efforts have since been made, and are now being applied, notably by the provision of a very powerful marine bucket-and-hopper dredge, to establish the desired depth and width of channel at the Mediterranean entrance, as well as to continue the systematic dredging of the channel within the shelter of the west jetty, which has been in operation since 1886. In order to maintain a minimum depth of 29 feet 6 inches at Port Said, 663,140 cubic meters were dredged between, and to seaward of, the jetties in 1898, and, in addition, 181,370 cubic meters of deposit were removed from the inner basins, exclusive of a cube of 565,800 cubic meters dredged from the canal itself between Port Said and Suez.

In the dredging operations at Port Said, the engineers happily hit upon the idea that it would be advisable to attack the deposits passing through the interstices of the west jetty, which was almost entirely composed of large concrete blocks thrown down at random, by dredging the newly-deposited sand under shelter of the jetty instead of beyond its head in the open sea. In order still further to check the growth of the sand bank seaward, the plan had also been adopted during a period of several years of removing and replacing from time to time portions of the superstructure of the jetty, near its root end, to allow the sand driven westward through the gaps during gales to enter the canal, where it could be easily dredged away. This rough method of breaking up and restoring the superstructure of the jetty over a length of about 300 yards had lately been superseded by the construction of a roadway from the shore, supported at its outer end by sixteen arches of masonry, each of 20 feet span, through which the sand now traveled freely in stormy weather.

On January 1, 1899, there was an available depth of 29 feet 6 inches over an aggregate length of 56 miles, and by continuing to dredge down to 31 feet, as at present practised, the engineers of the company hope by 1902 to obtain the latter depth throughout the whole length of the canal. It should here be explained that this contemplated depth of 31 feet in 1902 includes the provision of a receptacle for deposit 1½ feet deep over the entire bottom width of the canal from end to end.

At the Suez entrance, at the present time, a vessel drawing 25 feet 7 inches (the maximum draught allowed) has a depth of 3 feet 3 inches under her keel at ordinary low water of spring tides, and a minimum of 16 inches under her keel at an extraordinary low tide.

The following table, deduced from the "Comptes rendus" of the company, shows the quinquennial increase of traffic through the canal, and also the quinquennial increase of the revenue from December 31, 1878, to December 31, 1898:

Years.	Number of vessels.	Net tonnage.	Percentage of quinquennial increase of tonnage.	Average tonnage per vessel.	Revenue exclusively from taxes on shipping.	Percentage of quinquennial increase of revenue.
1873	1,173	1,367,767	...	1,170	£324,430	...
1874-78	7,471	10,363,330	...	1,390	5,410,265	...
1879-83	12,735	20,308,201	96	1,600	9,071,886	67
1884-88	16,585	30,518,765	194	1,770	11,700,000	116
1889-93	17,921	37,743,145	263	2,000	14,038,254	169
1894-98	16,684	42,185,817	306	2,270	15,124,595	180
1898	3,503	9,238,603	...	2,640	3,306,290	...

It has already been observed that the introduction of electric light has had the effect of virtually doubling the carrying capacity of the canal; but something more should be said, owing to the great importance of the subject, on the practical application of the system of lighting now in vogue for effecting the night navigation of the canal with ease, economy and safety.

At the close of 1885 it was decided to make use of electric light in such a manner as to ensure a safe passage by night through the canal, the company hoping in this way to diminish the traffic by day and thus render the navigation less difficult till the full enlargement of the waterway was accomplished. A system of leading marks, supplemented by Pintsch light buoys, was therefore established along the banks of the canal in order that the navigable channel might be clearly indicated.

It was soon recognized, however, that this system would be insufficient to ensure perfect safety, and thereupon it was decided that every vessel in motion during the night should itself be provided with the necessary apparatus to illumine her own passage through the canal. Accordingly it was arranged that every vessel passing by night should carry four lights, to one of which should be applied a powerful reflector, capable of spreading light 4,000 feet ahead of the vessel. Of the other three lights, one should be placed astern and one on each side of the ship. The Mangin reflector is generally used. Men-of-war and large postal steamers carry their own apparatus. Smaller vessels generally use a portable apparatus which they hire on entering the canal, returning it on leaving. The apparatus consists of a reflector, a dynamo and a motor. Besides the Mangin, several other kinds of reflectors are used with more or less efficiency.

The system of navigating by night as at present practised leaves nothing to be desired, inasmuch as the narrowness of the canal compels the adoption of the single line or block system in the transit of ves-

sels from sea to sea. Some other mode of lighting would, however, require to be arranged to insure the safe passing of vessels under way by night if the canal should ever be enlarged to the full dimensions contemplated by the directors in 1885; as the traffic managers of the canal are convinced by experience of the impracticability of two vessels in motion, carrying electric projectors, passing each other in contrary directions without danger, owing to the dazzling effects of the traveling lights on the vision of the pilots.

The first vessel that effected the through passage by night was the P. & O. steamer "Carthage," in 1886, the time of transit being 18 hours. In 1888, 46 per cent of the total shipping took advantage of the permission to steam through the canal day and night as compared with 71 per cent in 1889; the result being that for the whole navigation, the average passage for all vessels was reduced from 30 hours and 45 minutes in 1888 to 26 hours and 44 minutes in 1889. In 1898, 94 per cent of the total shipping made part of their passage by the aid of electric light, the average duration of transit being 17 hours and 22 minutes, and the minimum duration only 16 hours and 36 minutes, whereas the average time taken by steamers navigating by day was 28 hours and 20 minutes. These figures prove that the passage of the Suez Canal by night has become almost universal, to the immense relief of the navigation.

THE FENCING HORSE OF THE THIRD DRAGOONS.

THE fencing horse, devised by Fencing-Master Adjutant Monlun, of the 3d regiment of dragoons, at Nantes, presents the peculiarity that after one has seen it in operation he immediately asks himself why it was not invented a long time ago; it is so simple. But such simplicity does not exclude ingenuity, and in nowise robs M. Monlun of any of the merit of his very practical invention.

Up to the present, recruits have been exercised in the manipulation of the sword in quite a rudimentary way, especially at the inception of their instructions. The young recruit was placed upon any sort of a wooden horse whatever, with stationary dummies arranged around him within easy reach of his hands, one to the right, one to the left, one in front and one behind. Then he was ordered now to strike one and then another, by cut and thrust, according to the progression of the theory involved. This exercise was tiresome and monotonous, and consequently did not give the result desired. With Adjutant Monlun's mechanism, all this is changed. The tedious exercise of former times becomes exciting and pretty closely resembles real fighting. The soldier's "amour propre" enters into it, and something of the unexpected always occurs. The instructor himself, in manipulating the controlling wheel, becomes warmed up, and ends by identifying himself with the dummy, which he turns in every direction and every position around his pupil. The latter, while complying with the regulations and with the orders of the instructor, introduces into his work an ardor and an interest that have hitherto been unknown, and that, moreover, are shared by the spectators, officers, non-commissioned officers and young soldiers who are awaiting their turn and are impatient to enter into competition with their tow-stuffed adversaries.

But the movable apparatus is not employed solely for the instruction of the pupil placed in the center. Not only does it advantageously replace the five or six stationary dummies of the old sytem, but serves also as a target for half a dozen combatants, on foot or on horseback, armed with lath or lance, who, outside of the circle, lie in wait for it, strike it, prick it, split it and transpierce it with a conviction that gives one pleasure to witness. Let us add that the Minister of War, through a circular of September 13, 1900, authorized the commanders of cavalry corps to employ the fencing horse on condition that the expenses thereof be paid by the private fund of the regiment.

The price of 246½ francs is not of a character to frighten any one, and, if financial reasons have prevented the Minister from offering this mechanical horse gratuitously to the entire French cavalry, it is to be hoped at least that a number of colonels will decide to purchase it.—For the above particulars and the engraving, we are indebted to La Nature.

FRUITS: THEIR FORMS AND MODES OF DISPERSAL.*

By B. COCKBURN, Ph.C.

A FRUIT, in botanical language, is the ripened ovary or mature gynæcium; it consists of an outer covering, and the seed or seeds within. Now, the seed is a most important part of the plant, essential, as you all know, in the multiplication of the species. It is a young plant in embryo, capable of germinating and of becoming an independent individual. A plant lives for the preservation of the individual and the propagation of the species, and the safeguarding of reproduction always seems of more importance than even the life of the parent plant. Many instances might be given of a plant sacrificing its life for the sake of its seeds. The flowering and fruiting processes are the most important events in the whole life-history of a plant, and there is great expenditure of energy, and much complexity and ingenuity of contrivance shown in the details of this part of its cycle. The structure of the flowers is often connected with the visits of insects, and I will try to show that the form of the fruit is correlated with various external agencies.

The old idea that the beautiful and sweet-smelling flowers and luscious fruits were solely for the benefit of man has been exploded long ago. A plant lives for itself as an individual, and there are probably no instances of a plant assisting, in any way, another plant or an animal, except when this is at the same time advantageous to the plant itself.

The fruit may be large or small, hard or soft, smooth or prickly, sweet or bitter, dry or fleshy, and we shall go on to see that most, if not all, these characteristics are adaptive modifications of the plant, and give it some advantage in the struggle for existence.

Large numbers of fruits or seeds may be produced by a single plant, and the advantage of an efficient means of distribution is obvious. If seeds merely fell to the ground, there would be the evil of competition among the plants produced. Also, the soil is necessarily impoverished in the immediate neighborhood of the parent plant, and better conditions are to be found at a distance. Seeds are usually laden with a supply of food for the young plant, and thus there are two conflicting factors. One of these tends to increase the weight of the seed by storing up food in it, and the other to lighten the seed to facilitate distribution. Sometimes the fruit, sometimes the seed itself, takes up the task of distribution. The main factors concerned are wind, water, animals, and a propulsive mechanism in the plant itself. I purpose saying a little about each of these four agencies.

DISTRIBUTION BY WATER.

The dissemination in this way is not common, and not of very great importance in the vegetable kingdom. Of some interest is the case of the cocoa-nut. Only part of the fruit is known to most people. Outside of the hard shell which protects the seeds there is a fibrous coat, two or three inches thick. This covering enables the fruit to float, and protects it from the action of the sea-water, during, it may be, a long voyage. There can be no doubt that these fruits are carried great distances in this way. The presence of the cocoa-nut palm as the first, and often only, tree upon the coral island is sufficient to encourage the belief in the success of this instance of water distribution. Seeds of the water lily are said to sink to the bottom in autumn, and to lie protected from animals and cold all winter. In the spring they become lighter, rise to the surface, and may be washed ashore for germination. Fruits or seeds to be dispersed by water must be lighter, that they may float, and must be able to resist the injurious action of the water.

DISTRIBUTION BY WIND.

This mode of distribution is quite common, and very important. The fruits or seeds may be so small and light that wind-diffusion is easily effected. In this connection may be mentioned the spores of ferns and mosses. Though very different from fruits and seeds there is a certain resemblance, in that each spore can give rise to a new fern or moss plant. It is difficult to give any conception of the small size and immense number of these spores. It has been calculated that a single fern-plant may produce over 100,000,000 spores in one season. Then there are wonderful contrivances to insure the opening of the cases only in dry weather, and the scattering of the contents only by degrees. Among the higher plants, the orchids have very minute seeds. The effect of the wind may be reinforced by the presence of a broad flange of tissue, or a tuft of hairs. Many different parts of the fruit or seed are thus modified, and it is interesting to notice the same result accomplished in so many different ways. In some fruits part of the pericarp becomes flattened, and there can be no doubt that this expansion is to aid the action of the wind. It is pointed out by Sir John Lubbock that this would be of use only in the case of trees where the fruits have some distance to fall, and are exposed to higher wind. This is exactly what is found in nature. Fruits similar in this respect are to be found upon the ash, sycamore, maple, elm, lime, etc., and seldom upon plants of a shrubby or herbaceous habit. Plants of small height require a more effective modification, which usually takes the form of a tuft of hairs. Most familiar of this class is the dandelion, though many of the same order are well known, e. g., the thistles and hawk-bits. Seeds may be similarly modified. Those of firs and pines are provided with wings, while seeds of smaller plants have sometimes hairs attached. Examples are found in the

FENCING HORSE ADOPTED IN THE FRENCH ARMY.

* Read before the Glasgow Chemists' and Druggists' Assistants' and Apprentices' Association, on Wednesday, December 12, 1900.—Pharmaceutical Journal.

seeds of the cotton-plant, poplar, willow, epilobium, and strophanthus.

DISTRIBUTION BY ANIMALS.

Distribution by animals is brought about in two ways. The fruit may be eaten and the seed rejected, or it may be carried away mechanically by a passing animal. In the first case, there is present a succulent portion, usually part of the pericarp, by which the bird or other animal is attracted. The fruit is eaten and the seed rejected. The seed is guarded from injury by digestion through being inclosed in a hard shell, or by the stony nature of the seed itself. Examples of this are seen in the cherry, blackberry, grape, strawberry, and date. This is one of the best methods of seed distribution, because there is not so much left to chance. The animal scatters abroad the seed, and is repaid for its services by the food it receives. The bright color of the fruit is, of course, to render it conspicuous. Red is most common and contrasts well with the green of the leaves. Sometimes, when the fruits are small, they are grouped together in bunches, as in the case of the rowan, and so get over the disadvantage. This reminds us of the aggregation of small and inconspicuous flowers, as in the Compositæ and Umbelliferæ.

The Cape gooseberry or winter cherry is delusive in the way it makes itself attractive. A persistent, floral, envelope is brightly colored, and very much inflated. The actual edible portion is far less than might be expected from external appearances. Another interesting fruit is that of the mistletoe. There is a succulent, edible portion for which birds seek the fruit of this parasite. The bird, however, is not able to swallow the seed in this case because of a coating of very viscid substance around the seed. To get rid of the seed the bird rubs its beak against the branch of a tree, the seed sticks to the twig, and, if the tree is a suitable one for germination, the roots of the mistletoe penetrate into the tissues of the tree.

Fruits are known which resemble caterpillars, snakes, beetles, etc. These curious modifications are either to attract carnivorous or deceive graminivorous birds, but as a rule too little is known of the habits of the plant to enable us to decide upon the exact raison d'être of the presumed mimicry. The castor oil seed is a well-known example of this class, but there are many seeds which have a much more striking resemblance to beetles and other animals. That seed distribution by birds is effective was well illustrated some time ago in this way. An American currant used for giving color to wines was brought over to Europe and cultivated in Bordeaux and its neighborhood. The fruits were devoured greedily by birds, and the result is that now the plant has spread over France and Spain, and, indeed, is found over the whole of Southern Europe.

MECHANICAL DISTRIBUTION BY MEANS OF ANIMALS.

Fruits and seeds provided with strong, hooked hairs and spines attach themselves to passing animals, and are carried away. This is often a successful method, but the objection to it is the element of chance. The hooks may be derived from the teeth of a persistent calyx, from the style, or from an involucer of bracts, or the whole surface of the fruit may be covered with suitable hairs or spines. The distribution of cleavers, carrot, horehound, avens, burdock, and spinach is brought about in this way. It is again pointed out by Sir John Lubbock that in this case only plants of little height would be able to benefit by such hooks, and the theory is borne out by observation. Fruits of this kind are never found at any distance above the ground, and never upon water-plants. Sticky fruits may be carried away similarly. There are not many indigenous examples. The heads of grindelia are, when fresh, covered over with a sticky excretion of oleo-resin. In other cases, spiny or hard pericarps may serve to protect edible seeds from animals, and the external nature of the fruits of the star-nut, palm, beech, and Spanish chestnut may serve for such a purpose. Other fruits bury themselves in the ground before maturity, and seek protection in this way. The pea-nut and other fruits are forced below the soil, and ripen in this curious position.

MECHANICAL DISTRIBUTION BY EXPLOSIVE DEHISCENCE.

An ingenious mechanism upon some part of the plant may scatter the seeds to some distance, as in the case of the sling or catapult fruits. A tension set up in certain parts of the fruit, and a sudden disruption when fully mature, are the distinguishing marks of such fruits. The tension may be produced by the unequal lengths of parts of the fruit, or by the change which occurs in tissues on drying. Many examples might be given, but the aptness and versatility of modification in these fruits can only be appreciated by actual examination. The squirting cucumber is a striking example. It is of the nature of a berry, and the fluid contents are under great pressure. The ripe fruit falls to the ground, and as it leaves the stalk an opening is formed through which the contents, seeds and juice, are squirted with great force. A more typical example is the touch-me-not, a Japanese variety of which is commonly cultivated. When the fruits are ripe the slightest touch is sufficient to bring about the dehiscence of the capsule with explosive violence. Similar in their methods of splitting open are the siliquas of many Cruciferæ, and the fruits of the Leguminosæ, Geraniaceæ, Violaceæ, etc. By this means of distribution the seeds are not so likely to arrive at a distance from their parent, as by those already considered. Probably a few yards is about the average.

SPECTRA OF RADIUM AND POLONIUM.—By means of Runge's method of fusing the salt into a platinum coil and then using it as an anode for a spark-gap, G. Berndt has discovered no less than 15 lines of the polonium spectrum. This is all the more interesting as no measurements of the lines due to polonium had yet been made. The two strongest lines in the photographic spectrum have a wave length of 3,361.5 and 3,349.2 Angström units respectively, with a maximum error of 1.5 units. Active bismuth nitrate of intensity 300 was used for the measurements. For extending the known spectrum of radium, the author used active barium chloride and bromide. Salts of the intensity 240 only gave the radium line at 3,814.59. But a salt of activity 1,000, prepared in Paris, gave, in addition, the lines 4,682.346, 3,814.591, and a new line 2,708.6. Down to $\lambda = 2{,}100$, no further radium lines were found. The spark was in all cases furnished by two Leyden jars charged by a large induction coil, and the platinum coil was kept in a state of incandescence. Under these circumstances, the space between the electrodes was filled with the vapor of the salt, and the platinum and air lines were quite faint.—G. Berndt, Phys. Zeitschr., December 22, 1900.

THE BURNING OF A BAKU OIL DEPOT.

FROM Baku comes the news that a fire broke out on February 5, in one of the huge oil-tanks of the Caspian and Black Sea Company. In the tank some six million poods (about 166,666 pounds) of petroleum were contained, which in burning set fire to three other storage reservoirs with a capacity of 12,000,000 pounds. The result was a frightful catastrophe. Workmen's dwellings were inundated with burning oil, and many persons lost their lives. Up to the present twenty charred bodies have been found. Fifty persons were terribly burned. Four hundred families were made homeless.

THE BURNING BAKU OIL STATION.

Russian oil-fields have been visited by other fires, which fortunately were not always accompanied by the appalling loss of life which marked the last conflagration. Our French contemporary, L'Illustration, assures us that not so long ago an oil depot on the road from Petrovsk to Vladikaukaz, in southern Russia, was swept away by fire. The conflagration, it is said, was a most imposing and terribly beautiful spectacle. The Baku oil fields have been described and pictured in the SUPPLEMENT more than once. In output they are surpassed only by our own Pennsylvania fields. One of the peculiarities of these Russian springs is the enormous pressure under which the oil bursts forth. The wells are drilled after the American fashion. The oil is found at depths ranging from ten to six hundred feet. When struck, the oil spurts out to a great height and is thus wasted. One of the Nobel wells spouted 50,000 barrels a day; and others have proved equally unmanageable.

DANGERS FROM DUSTY TRADES.

A RECENT investigating committee of the British Parliament, appointed to inquire into the dangers of certain trades and operations, finds that there is peculiar harm in those that involve working in an atmosphere laden with dust, sometimes because this dust is poisonous, but often simply because it is irritating to the air passages. From a summary of the results, published in The Hospital, we quote the following:

The connection between dust and disease has often been noted; and even the ordinary dust of the street and the household carries insidious dangers; but these are not so sure in their action as those carried by the dust raised in various manufacturing processes. Take, for example, the work of paper staining. In the old days there was a great fancy for what was called "flock" papers; they were regarded as handsome and comfortable looking, and after a long period of neglect flock papers are beginning again to come into fashion. Fashion is thoughtless rather than cruel in her fads, and therefore it may be well to point out how the process of "flocking" is carried out. The paper having had the pattern outlined on it, the parts to be flocked are covered with a thin coat of size, and are then dusted over with the flock—a sort of felt dust—which is shaken out of something like a pepper caster. This flock adheres to the parts that are coated with size, and when it has dried upon them the remainder is shaken off. All through the process dust is in evidence, penetrating to the worker's nostrils and lungs, irritating the membranes and causing disease.

Very similar to this is the process of bronzing, as applied to paper or leather. Here also the powder is dusted on to the prepared surface, generally by means of a pad, and the worker is exposed to the dangers of inhaling it.

The employment of "flake white" or "Chinese white" is also injurious when these substances contain lead, and when they are dusted on in powder. Some forms of flake white are harmless, while others are more than half white lead, the remainder being French chalk. Says the writer:

One firm which had used this compound, finding that some cases of illness resulted among those employed,

gave it up, and employed instead a powder called "metallochrome," which was composed of sulphate of barium and was quite free from lead. This change did away with one important danger for the workers in this industry—which is, fortunately, a very small one—that of lead-poisoning.

When the dust is more than half white lead, it is peculiarly dangerous to health; but even without absolutely poisonous stuff being included in it the mechanical irritation to throat, lungs and nostrils is sufficient to condemn it. It is a trade at which no one seems to work long, though, as it is light work, there is no difficulty in filling up such vacancies as arise.

Among other dusty and dangerous industries may be noted the manufacture of basic slag. Basic slag is the refuse that is left in the converter after making steel by the "Gilchrist Thomas" process, and is valuable as a manure. In order to be used for this purpose, however, the slag, which comes out of the converter in large pieces, must be ground into a powder so fine that from eighty to eighty-five per cent of it would pass through a mesh of 10,000 to the square inch. Sometimes, if very dry, the slag is moistened before being ground; but in spite of this, much dust arises in the process of repeated grinding, which is necessary to reduce the slag to powder. Time and time is the process repeated, the fine dust being carried away by a fan to hoppers, from which it falls into bags without being touched by hand, while the heavier dust is carried into a chamber which must be cleared every six weeks. The men who perform this duty wear respirators. The dust given out by the slag in process of grinding is not in itself of a poisonous nature, but it causes, by its mechanical irritation, huskiness, asthma, and even pneumonia. It is chiefly in the packing of the dust that the workmen encounter danger, though this may be kept in check by the rejection of old or unsuitable bags. In one factory only new jute bags are employed. A peculiar case occurred some time ago at Ellesmere Port. A laborer, not employed in any mill, but only in unloading bags of basic slag, died of pneumonia, and at the inquest it came out that the disease had arisen from inhaling the dust. It is evident that respirators or veils should be used by those employed at every stage of the process.

Silicate cotton is another slag product, in the making of which much dust arises. The process by which it is made is simple and ingenious. A fine stream of molten slag is met on issuing from the furnace by a strong blast of steam. By this small globular particles of slag are formed and are driven with great velocity into a chamber; from each of these particles, by reason of their viscous nature and the velocity with which they are forced through the air, is drawn a long thin filament. These filaments combine into a thread-like, spongy material, the silicate of cotton—or, as it is generally called, slag wool. This material is absolutely non-inflammable, and is a non-conductor of both heat and of sound. It is thus of great use in packing the pipes from steam boilers, engines, etc., for laying between floors to deaden the sound, to render walls and floors fireproof, and very largely for cold storage purposes. In appearance it resembles cotton wool, but has no elasticity. It is very light. The dangers that accompany the manufacture are, again, the risk of inhaling particles of the slag wool while packing it. The fine particles of wool cause great irritation to skin and nose to a stranger, though it is said that the workers themselves get quite accustomed to it. It has been shown, however, that the irritation has caused several persons to give up the work. The employment of crape or muslin veils has been found to afford great relief from these symptoms.

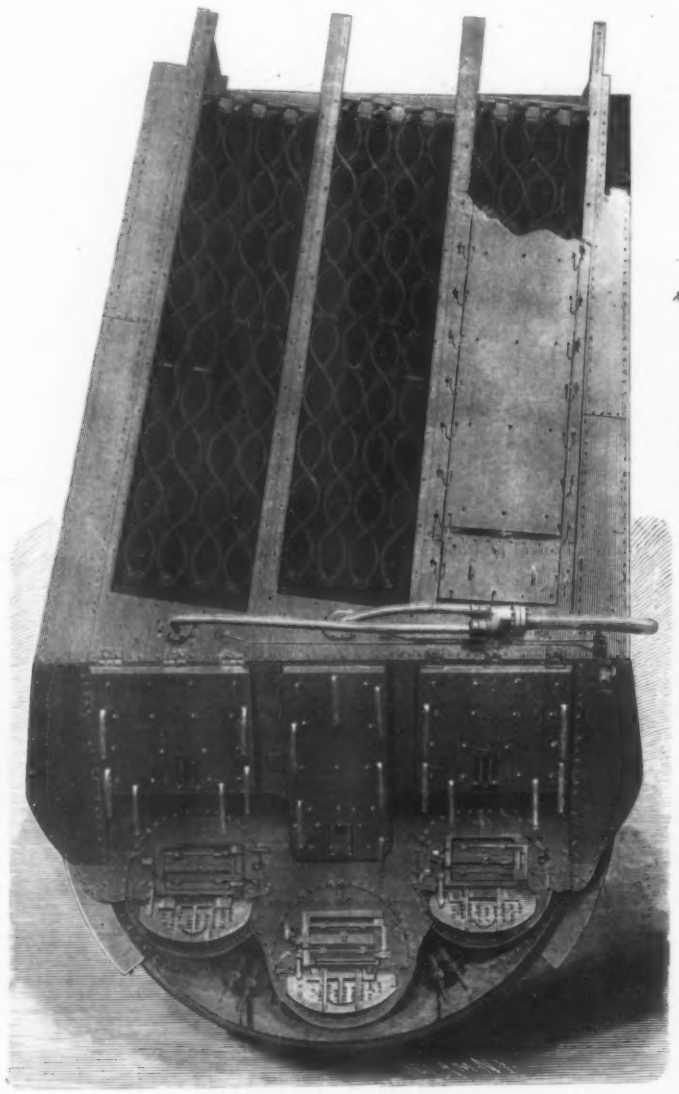
ENGINES AND BOILERS OF THE "INCHDUNE" AND "INCHMARLO."

THE machinery of the vessels "Inchdune" and "Inchmarlo," belonging to the Inch line of steamers, which is owned by Messrs. Hamilton, Fraser & Co., of Liverpool, is of very great interest, not only from its construction, but also on account of the highly economical results which have been obtained by it. The engines, constructed at the Central Marine Engine Works, West Hartlepool, are a modification of the quadruple-expansion five-crank type, advocated by the late Mr. Mudd, and fitted to the steamship "Inchmona." The alterations made in the design have been fully justified by the results obtained, both as regards actual working of the machinery and economy of fuel. The working pressure has been increased to 267 pounds per square inch, and the steam is superheated to a temperature approaching 500 deg. F. The general result is that on an extended trial from Hartlepool to Dover the coal consumption was at the unprecedentedly small rate of 0.97 pound per indicated horse power. If we increase this to 1 pound, it works out to 15½ tons per day for a ship carrying 6,170 tons at 9½ knots or to 13¼ tons at 9 knots. In other words, 1 ton is carried 1 nautical mile on an expenditure of about one-third of an ounce of coal. Taking coal at 15 shillings a ton, 1 ton of cargo is carried over 550 miles for an expenditure of 1 penny for fuel.

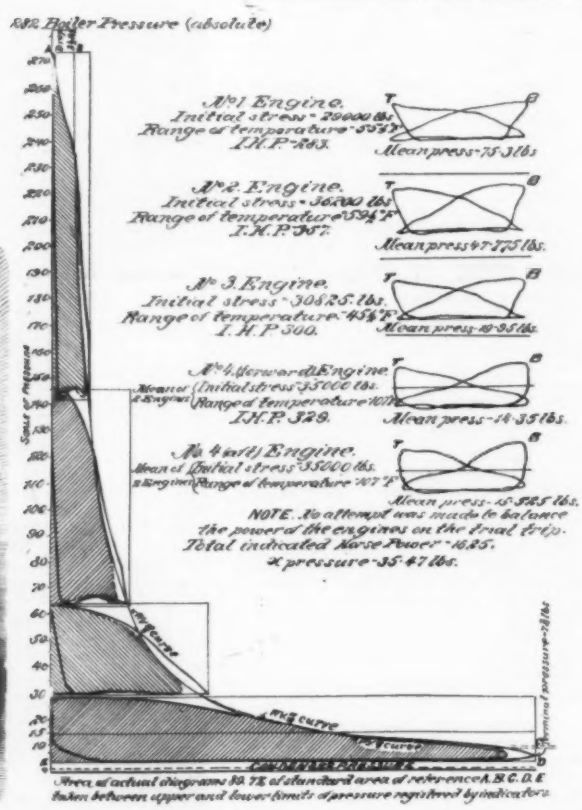
The engines have five cylinders, two of them being low-pressure cylinders, the expansion being done in four stages. The diameters of the cylinders are respectively 17 inches, 24 inches, 34 inches, 42 inches, and 42 inches, the stroke in every case being 42 inches. The high-pressure valve is of the piston type, all the others being ordinary flat valves. All the cylinders are fitted with liners, which permits of complete jacketing, with the exception of the high-pressure, which is lined, but not jacketed. Special care has been given to this feature of the arrangement, the cylinders being completely enveloped by a jacket of steam, on sides, tops and bottoms, and over and above is fitted a thick lagging of non-conducting material, that on the tops being composed of asbestos blankets protected by iron casings, so adjusted that they can be removed with facility for the purpose of overhaul. The general design of the engines is that in vogue at the Central Marine Engine Works. The front columns are of wrought iron, the high-pressure cylinder, the first mean pressure cylinder, and the first low-pressure cylinder being supported at the back on columns cast as part of the condenser. The remaining two cylinders rest, as usual, on cast-iron columns of box section on the bedplate. There are ten main bearings supporting the crankshaft, which is composed of five interchangeable parts.

Interesting as the engines are, they must give place to the boilers and superheaters, which, of course, were also made at the Central Works. The boilers are two in number, and 13 feet in diameter by 10 feet long. On the trial they provided steam for 1,600 indicated horse power without the slightest difficulty. The boilers are single ended and are worked with Ellis and Eaves' system of induced draught. They are of the ordinary Scotch type, but are constructed to carry the very high pressure of 267 pounds per square inch. In the uptake, immediately above the level of the highest row of tubes, is the "Central" superheater, a device designed and patented at the Central Marine Engine Works. It consists (see engraving) of three divisions, in each of which are two cast-steel headers. Between these are 168 waved tubes, through which the steam passes on its way from the boiler to the engine, entering at the top and leaving at the bottom. The waved form of the tubes insures that the steam shall be continually agitated, and that all parts shall come in contact with the hot metal. The lower part of the waved pipes is naturally hotter than the upper part, for the gases from the boiler strike here, and hence the steam is heated progressively, while the gases are cooled in the same manner. When they leave the top of the superheater they flow up through nests of vertical pipes to the fan, by which they are aspirated and forced into the funnel. These vertical pipes heat the air which is drawn into the furnaces by the fans, the air entering through openings in the casings, and flowing downward among the pipes, and thence to the ashpits.

The annexed figure gives a series of diagrams for all the cylinders, together with a combined diagram. It is to be noted that no attempt was made to balance the power of the engines on the first trip when these diagrams were taken. The powers developed in the various cylinders were as below:



ONE OF THE BOILERS OF THE "INCHDUNE."


Boiler Pressure (absolute)
No. 1 Engine.
Initial stress - 29000 lbs.
Range of temperature - 55½°F.
I.H.P. 263.
Mean press - 75.3 lbs.
No. 2. Engine.
Initial stress - 36200 lbs.
Range of temperature 55½°F.
I.H.P. 367.
Mean press 47.775 lbs.
No. 3. Engine.
Initial stress - 30825 lbs.
Range of temperature 45½°F.
I.H.P. 300.
Mean press 19.95 lbs.
No. 4. Forward Engine.
Mean of Initial stress 35000 lbs.
2 Engines. Ranged temperature 107°F.
I.H.P. 329.
Mean press - 14.35 lbs.
No. 4 (aft) Engine.
Mean of Initial stress 35000 lbs.
2 Engines. Range of temperature 107°F.
Mean press - 15.525 lbs.
NOTE. No attempt was made to balance the power of the engines on the trial trip.
Total indicated Horse Power - 1625.
Mean pressure - 35.47 lbs.
Scale of Pressure
Vacuum
Terminal pressure - 28 lbs
Area of actual diagrams 89.7% of standard area of reference A.B.C.D.E.
taken between upper and lower limits of pressure registered by indicators.

DIAGRAMS OF THE FIVE-CRANK ENGINES OF THE "INCHDUNE."

	Horse Power.	Mean Pressure.	Range of Temperature.
		lb.	deg. F.
High-pressure cylinder	263	75.3	55½
First intermediate pressure cylinder	350	47.775	50½
Second intermediate pressure cylinder	300	19.95	45½
Forward low-pressure cylinder	329	14.35	107
Aft low-pressure cylinder	356	15.525	107

It will be seen that there is some wiredrawing in the first cylinder due to the superheater. This will be remedied in future engines. The dotted areas in the combined diagram follow very closely the $PV^{1.06}$ curve down to the low-pressure diagram, after which they conform more closely to the $PV^{1.13}$ curve. The total area of the actual diagram is 87.9 per cent of the standard area of reference *A B C D E*, taken between the upper and lower limit of pressure registered by the indicators.

The boilers are fitted with Messrs. John Brown & Co.'s Serve tubes, and arched ribbed furnaces. The use

of Serve tubes enables smaller boilers to be employed than otherwise would be needed. The high pressure necessitates the use of a very thick shell (1 19-32 inches) and very stout stays. The shell is made of three plates, butt-jointed, with covering plates inside and out. The shell is flanged at each end, and to render this possible the plates are welded for a short distance. Great pains have been bestowed to the lagging of the boiler and steam pipes, since at such pressures the losses by radiation may be very great.

The other novel feature in the design of this installation are the means of heating and purifying the feed-water before it enters the boilers, and the trapping of the water condensed in the cylinder jackets. In high-pressure boilers, such as those described above, too much attention cannot be given to the treatment of the feed-water before it enters the boilers. It must be of as high temperature and as free from impurities as is economically possible, and it is also highly important that the internal surface of the boiler should be protected against oxidation, and for this reason the air held in suspension in the feed-water should be got rid of. To effect this the feed is, in the first place, pumped from the hotwell through a contact heater, as made by Messrs. G. & J. Weir, of Glasgow, where its temperature is raised to about 223 deg. F., and where any air it may hold is eliminated. From this contact-heater it is passed by means of a pair of Weir's feed-pumps through a surface-heater to the boilers. In this heater the temperature should be about 400 deg. F., or nearly that of the steam in the boiler. It is while being pumped from the hotwell to the contact heater that the feed-water is passed through a pair of filters, designed by Mr. J. B. Edmiston, superintendent engineer of the line. This enables the water to be put through the filtering process, while still under low pressure and at a comparatively low temperature, a fact which contributes in no small degree to the filtering being more efficiently performed.

The complete data of the cycle of temperatures in these engines are given in the annexed table, where the gradual rise in heat of the water from the hotwell at 96½ deg., through the contact heater (113 deg.) and the surface heater (370 deg.) to the boiler at 412 deg., can be followed. The steam enters the superheater at 412 deg., and leaves at 469½ deg. to begin its downward course; first losing 22½ deg. on its way to the high-pressure chest, and then being expanded in four stages, as shown by the diagrams, until it returns to the condenser. The temperature of the air can be also traced from the deck at 53 deg. through the heater to the furnace, which it enters at 299 deg., leaving the smoke-tubes at 587 deg. The gases lose 44 deg. in the superheater and 41 deg. in the air-heating tubes, and enter the fan at 404 deg. All the heat is saved that is possible, the temperature at the fan discharge being only 319 deg. F., or more than 90 deg. below the temperature of the steam in the boilers. The success of the installation has been attained not only by the courage evinced in undertaking the use of superheated steam, which has been so often tried and so uniformly abandoned, but also by infinite care in securing a large number of small economies, which add up to a very considerable amount. Superheated and high-pressure steam has its own special sources of loss, and if these are not guarded against most carefully, it is quite possible that they may quite equal the theoretical gains.

LIGHT TRIAL IN BALLAST TRIM OF STEAMSHIP "INCHMARLO," OCTOBER 26, 1900.

Draught, forward	10 ft. 4 in.
Draught, aft	15 ft. 5 in.
Draught, mean	12 ft. 10½ in.
Reversing and expansion gears	Full out
Intermediate stop valve on engine	Full open
Steam stop valves, to and from superheater	¾ open
Pressure of steam in No. 2 cylinder jacket and covers	103 lb.
Pressure of steam in Nos. 3 and 4 cylinder jacket and covers	68 lb.
Temperature of superheated steam in jacket coil of No. 2 receiver chest	470 deg. F.
Feed temperatures—hotwell	96½ deg. F.
Inlet to contact heater	113 deg. F.
Outlet from contact heater	209 deg. F.
Outlet from surface heater to boilers	310 to 370 deg. F.*
Temperature of sea water	54 deg. F.
Temperature of discharge	97 deg. F.
Temperatures, deck	53 deg. F.
Temperatures, engine-room	75 deg. F.
Temperatures, stokehold	77½ deg. F.
Heated air entering furnaces	299 deg. F.
Waste gases below superheater	587 deg. F.
Waste gases above superheater	543 deg. F.
Waste gases above heating tubes	404 deg. F.
Waste gases at fan discharge to funnel	319 deg. F.
Steam at inlet to superheater pipes (267 pounds)	412 deg. F.
Steam after passing through superheater	469½ deg. F.
Total superheat above temperature due to boiler pressure	57½ deg. F.
Steam at high-pressure steam chest	447 deg. F.†

In connection with the jacketing of the cylinders, one very important point to be considered in aiming at economy in steam is the trapping of the condensed water. Hitherto this has been a source of great waste, as, when the traps are not in working order, steam, as well as the condensed water, escapes. To combat this waste and to effect as perfect trapping as possible, the Central Marine Company have designed and patented a special trap, which has, we think, the merit of being novel. It may be described as being a positive action trap; it depends for its action upon a reciprocating internal piston, lifting the valve from its seat by means of the water trapped. If no water be in the trap, no lift takes place, whereas, if water fills the trap, the valve, of necessity, must lift. On the trials the efficient working of these traps was proved by the dryness of the jackets and the temperature of the water in the drain-pot into which the traps led, the one showing that no water was lodging in the jacket, and the other that no steam was passing from the jackets.

Every credit is due to Messrs. Hamilton, Fraser & Company for being the pioneers in such a decided departure in marine engine practice. It is interesting to note that the Central Marine Works are at present fitting an exact duplicate of this machinery into the new steamer "Nassovia" for the Hamburg-American Line, Hamburg.—Engineering.

* The fluctuation of temperature of feed to boilers was due to the trapping arrangements being insufficient in size.

† Drop in temperature between superheater and engines due to insufficient lagging.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Transportation in the Congo.—The department of marine and public works in the Congo Free State has made considerable improvements in the means of intercourse, as well on the rivers as on the sea, between Boma, Matadi, Angola, and the French coast. The Messageries Fluviales, of the Congo, have opened offices at Matadi, Brazzaville, and Messo and carry goods as far as Brazzaville, situated on the banks of the French Congo, from any of the following European ports: Bordeaux, Antwerp, Hamburg, or Liverpool. The freight rates on the Congo River and its auxiliaries, as well as the charges for reloading and unloading, will soon be published. On the Middle Congo three wood stations have been established by the government, to enable steamers plying on the river to take in fuel.

As regards the project to make the Kingussi Canal navigable for small steamboats, the commissary of the Kwango district reports that the dredging is progressing favorably and that already, in September last, the bottom of the canal was 30 centimeters (11.8 inches) below the lowest watermark. For a distance of 1,200 meters (3,937 feet) the canal will run in quite a straight line, and there will be no obstacles to navigation in the shape of rocks, etc. It is expected that after November 1, 1900, 10-ton steamers will be able to use it, even during the dry season. The first trials of the kind of steamboat necessary for the navigation of the Kwango River will be made immediately after that date, under the personal supervision of Mr. Costerman, the government inspector in charge. The Kwango district will then be connected with Stanley Pool by a direct river route, while previously goods had to go a roundabout way on the backs of native carriers.—Oliver J. D. Hughes, Consul at Coburg.

Canadian Lumber Exports.—The lumber exports from Montreal, the principal port of the Province of Quebec, have been carefully totaled from the customs manifests and show a decrease from last year of about 50,000,000 feet. The marked features in the export lumber trade for the past season have been the steady advance in values and the firmness with which stocks have been held, principally owing to the destructive fire at Ottawa in April. The earlier shipments, however, made in fulfillment of existing contracts that were taken at but a slight advance over last year's prices, met with a sharp rise in ocean freight rates which materially reduced shippers' margins. Owing to the Ottawa fire only 40 per cent of the shipments from Montreal came under summer insurance rates, while 60 per cent were under extreme autumn rates. The opening spring rates of freight ranged from 45s. to 50s. ($10.93 to $12.15), according to port of destination. Summer and autumn rates ranged from 60s. to 75s. ($14.58 to $18.22), the latter having been paid for special ports. It is said that the lack of ships caused the increase in freight rates.

The following figures show the export lumber trade for the season of 1900, as per custom house returns:

	Feet.
Quantity exported	226,996,857
To South America	463,765
Total	227,460,622
Quantity shipped last year	280,063,787
Decrease	52,603,165

Some two dozen replies to letters sent out by The Canadian Lumberman were published in the last edition of that paper. These replies go to show that logging operatives are unable to obtain a sufficient number of employes. Wages and food have advanced, and the chances are that the output of logs will be materially reduced. The Lumberman adds that the increase in the wages of woodsmen in the United States has amounted to nearly 85 per cent during the past four years. It is believed that there has been an almost equal advance in Canada. This increase cannot be disregarded by manufacturers, who must of necessity secure for their product a price sufficient to cover the higher cost of production.

The consumption of lumber for manufacturing purposes is likely to grow. In addition to a steadily growing home demand, the export of furniture and wood implements is increasing. It is not improbable that the United States and Great Britain will take from Canada next year fully as much, if not more, lumber than in the season now closing.—Felix S. S. Johnson, Commercial Agent at Standbridge.

Cultivation of Hybrid Vines in Austria.—The Austrian Ministry of Agriculture is giving a good deal of attention to propogating hybrids of American and American-European vines. Such hybrids are not only supposed to be the most suitable stocks for lime soil in general, but are also, on account of their nearer relationship, better adapted to serve as stocks for the rather delicate scions of highly improved species than the common non-resistant vines of American origin, which have been heretofore used for the purpose.

The ministry also imported last spring from France a quantity of newly propagated hybrids of which there had previously been but very few or no specimens at all in Austria. As the board of agriculture had recommended that every precaution be taken to prevent the introduction of the much dreaded "black rot," the vines were sent to Schärding, in Upper Austria, a district in which wine is not produced. The fact that the president of the Imperial Royal Agricultural Society of Upper Austria placed at the disposal of the Ministry of Agriculture a suitable tract of land for a quarantine nursery greatly aided the enterprise. The soil was well prepared and manured, and much care has been bestowed on the vines. The results obtained have been most satisfactory, the plants having thrived beyond expectation.

This nursery contains at present twenty thousand hardy specimens of thirteen different American and French-American varieties of hybrids. In the spring of 1901 they will be distributed for trial in the various wine-growing districts.

The confidence of the Austrian growers in these trial vines has been greatly increased by the fact that the bacteriological department of the agricultural experiment station in Vienna announces that it has made several careful examinations of the nursery in the course of the season, and has found it entirely free from black rot.—Frederick W. Hossfeld, Consul at Trieste.

Industrial Organization in Germany.—At the November meeting of the Manufacturers' Society of the Middle Rhine, Dr. Fuld, LL.D., delivered an address on the organization of industries. The speaker pointed out that the German government, which during the first half of the nineteenth century was opposed to such movement, has lately become converted to the necessity and advisability of organization. Thus, boards of agriculture have been established in the interests of the farmer and boards of labor in the interests of the workingman; only in the interest of the manufacturers have no boards, as yet, been established. It devolves upon the manufacturers themselves to take the initiative in organizing a national industrial council.

The chambers of commerce cannot be regarded as representative of manufacturing interests, as with them commerce plays the most important rôle, and they are inclined to advocate the doctrines of free trade, which are by no means shared by the manufacturers.

The speaker urged a strong centralization of industries, as necessary in view of the demands of the agrarian and commercial interests, especially at the present time, during the preparation of new trade treaties.

It appears that the conviction has grown upon the manufacturers that such a centralization would be of immeasurable value to them, and three of the strongest industrial societies of Germany convened to organize a national industrial council. The Imperial government was apparently in sympathy with the movement, but so far the efforts have failed. Nevertheless, the speaker argued, it must be the constant aim of the manufacturers to call into existence such a central organization. The manufacturing interests of Germany will surely demand the passage of a protective tariff during the present session of the Reichstag.—Walter Schumann, Consul at Mayence.

Blankets in South Africa.—Vice-Consul-General Hanauer, of Frankfort, under date of December 4, 1900, says that the Belgian Consul in Pretoria, Transvaal, reports that blankets made of shoddy find large sales among the Kaffirs in South Africa. These blankets, called "Koogs," are made at Dewsbury, England, and are from 64 by 68 to 72 by 84 inches in size, weighing 4½ and 5 pounds, respectively. They come in three different qualities, and have broad red, yellow, and blue stripes on both sides. The importation of these blankets during 1899 amounted to $370,000.

Extension of Beet-Sugar Industry.—Consul Hughes writes from Coburg, December 4, 1900:

On account of so many countries having turned their attention to the cultivation of beets for sugar, the markets of the world are becoming glutted. The European producing lands are Germany, Austria, Russia, France, Belgium, Holland, Sweden, Denmark, Servia, Bulgaria, Roumania, Switzerland, Italy, Greece, and Spain. Persia is just entering the field; Egypt is realizing that her soil is adapted to the cultivation of the beet; the United States is pressing them all, with Argentina and Chile trying to follow in her footsteps. Spain, of late years, has taken great interest in the industry. In 1898 she imported 339,619 kilogrammes (748,724 pounds) of sugar, but in 1899 she only received 9,229 kilogrammes (20,346 pounds) and according to the present outlook she will import no sugar in 1900.

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No. 950, February 1.—Canadian Poultry in England—*Steamship Lines at Panama—*Meeting of Iron Manufacturers of Russia—*Russian Importation and Production of Coal.

No. 951, February 2.—Birmingham's Food Supply—Spelt in Manitoba—Lumber Trade in New Brunswick.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Aromatic Wadding.—According to Karl Fr. Töllner aromatic wadding is produced as follows: Mix camphor, 5, pine-leaf oil, 5, clove oil, 5, spirit of wine (90 per cent), 80, and distribute evenly on wadding, 500, by means of an atomizer. The wadding is left pressed together in a tightly closed tin vessel for a few days. —Deutsche Drogisten Zeitung.

Care Required in Working with Acetylene.—Actuated by the recent acetylene explosion at Nuremberg, which must be laid to incomprehensibly thoughtless procedure on the part of the experimenter, an experienced engineer, Engineer Herzfeld, once more calls attention to the precautionary measures, which apply to all acetylene apparatus without distinction: 1. In every acetylene apparatus, no matter whether a bicycle lamp or a larger plant, light the acetylene only at the burners. 2. Search for leaky places, especially when giving an apparatus a first trial, only by brushing with soap water and not by means of a light. 3. Allow the gas-air mixture forming in the apparatus during the first few minutes to escape unburnt into the open for the sake of precaution.—Monatschrift für die Textil Industrie.

New Air Purifier.—A new ingenious process to improve unhealthful room-air at once has recently been invented by a French physician. Similar to the well-known Seidlitz powders, he incloses a scent in two different papers, one of which contains white barium peroxide, which is saturated with perfume in a concentrated form. This is first placed in tin foil or oil paper. The other blue paper contains powdered potassium permanganate in the correct proportion, so that on mixing the two bodies together in a solution, oxygen is set free, which spreads the scent in the air and improves the bad air in the room. If the powder is to be used for disinfecting purposes the perfume may, of course, be left out. For sick-rooms and wherever an opening of the windows is not desirable or impracticable, this new air-purifier will doubtless prove of great value.—Pharmaceutische Post.

To Remove Rust from Iron.—To clean rusty iron the following simple process may be employed. The rusty piece, no matter how far the rust has progressed, is connected with a piece of zinc and then introduced into water containing a little sulphuric acid. After the articles have been lying in the liquid for several days or a week, the rust will have completely disappeared. The length of time will depend upon how deep the rust has penetrated. A little sulphuric acid may be added from time to time to reinforce the solution, but the chief point is that the zinc always has a good electrical contact with the iron. To insure this an iron wire may be firmly wound around the iron object and connected with the zinc. The method presents the great advantage that the iron is not attacked in the least, as long as the zinc is kept in good electric contact with it. When the articles thus treated are taken from the liquid they assume a dark gray or black color and are then washed off and oiled. —Metallarbeiter.

Production of "Braga," the Roumanian Drink.—Braga is a much demanded beverage in the Roumanian cities, especially during the hot summer months. It is a product of the alcoholic and acid fermentation of millet. Owing to its contents of acid, especially of lactic acid and carbonic acid, it is a very cooling drink. It is especially popular owing to the ice which is placed direct in the liquid and by reason of its low price. The production of braga does not constitute an industry based upon scientific observations, but is about in the same stage as beer-brewing was a few hundred years ago.

Braga is a liquid of milky turbidity, resembling café au lait in color, and forming a considerable precipitate if left alone. When shaken it effervesces and a little carbonic acid escapes. Its taste is more or less acidulous, possessing a pleasant flavor peculiar to braga.

The mode of production of braga is very simple: About 35 kilos. of crushed millet, to which a little wheat flour is added, is placed in a large kettle. On this about 400 liters of water is poured. The mixture is stirred well and boiled for three hours. After a rest of one hour the lost water is renewed and the boiling continued for another ten hours. A viscous mass remains in the kettle, which substance is spread upon large tables to cool. After it is perfectly cool, it is stirred with water in a wooden trough and left to ferment for eight hours. Now this pulp is sifted, mixed with a little water and after an hour the braga is ready for sale. The taste is a little sweetish at first, but becomes more and more sourish in time. As will be seen the fermentation commences only in the trough.—Neueste Erfahrungen und Erfindungen.

Hair Washes.—

Hair Embrocation.

	Grammes.
Almond oil, sweet	280
Spirit of sal ammoniac	280
Spirit of rosemary	840
Honey water	840

Mix. Rub the scalp with it every morning by means of a sponge.

Hair Restorer.

Tincture of cantharides	7	grammes.
Gall tincture	7	grammes.
Musk essence	20	drops.
Carmine	0.5	gramme.
Rectified spirit of wine	28	grammes.
Rose water	140	grammes.

To be used at night.

Rosemary Water.

Rosemary oil	30	drops.
Rectified spirit of wine	7	grammes.
Magnesia	7	grammes.
Distilled water	1000	grammes.

Mix the oil with the spirit of wine and rub up with the magnesia in a mortar, gradually add the water and finally filter.—Journ. de la Parf. et Sav. Franç.

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